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Standards

American Standard Code for Information Interchange

Sponsor

Business Equipment Manufacturers Association

Approved June 17, 1963

AMERICAN STANDARDS ASSOCIATION
INCORPORATED

NBS/228/4

American Standard

Registered United States Patent Office

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Foreword

(This Foreword is not a part of American Standard Code for Information Interchange, X3.4-1963.)

This American Standard presents the standard coded character set to be used for information interchange among information processing systems, communication systems, and associated equipment.

Subsequent standards will prescribe the means of implementing this standard in the principal media, such as perforated tape, punched cards, and magnetic tape. Other standards will deal with collating and error control considerations. These standards will facilitate the interchange of digital information.

The 7-bit coded character set was developed by a group of highly qualified and experienced specialists in information processing and communication.* Past work in the field was reviewed, and a comprehensive program of original research and code design completed. Careful consideration has been given to the several conflicting code set requirements, and their resolution achieved in the standard code.

This standard was approved as American Standard by the American Standards Association on June 17, 1963.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the American Standards Association, Incorporated, 10 East 40th Street, New York 16, N. Y.

The ASA Sectional Committee on Computers and Information Processing, X3, which developed this standard, had the following personnel at the time of approval:

C. A. PHILLIPS, *Chairman* R. E. UTMAN, *Secretary*

Air Transport Association of America	F. C. WHITE
American Bankers Association	G. W. FREY
American Gas Association and Edison Electric Institute (jointly)	R. E. HARBAUGH
American Management Association	G. N. STILIAN
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National Retail Merchants Association	ETHEL LANGTRY
Telephone Group	L. W. CLAUSSEN
U. S. Department of Defense	G. L. BOWLBY

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* Operating under ASA Project X3, Computers and Information Processing. The Business Equipment Manufacturers Association serves as sponsor of the X3 project.

At the time the proposal was developed and processed through ASA X3.2 subcommittee, the subcommittee membership was as follows:

C. E. Macon, *Chairman*
Burroughs Corporation

I. Liggett, *Former Chairman*
International Business Machines Corporation

R. E. Utman, *Secretary*
Sperry Rand Corporation

J. F. Auwaerter
Teletype Corporation

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IBM Corporation

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National Cash Register Company

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Teletype Corporation

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Minneapolis-Honeywell Regulator Company

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W. J. Leubbert
U.S. Military Academy

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IBM Corporation

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Friden, Inc

A. J. Ungar
International Electric Corporation

A. L. Whitman
Bell Telephone Laboratories

It should be recognized that although X3.2 members are variously affiliated, work on an ASA subcommittee is achieved primarily on an individual competence and experience basis. The membership above has with some exceptions been continuously active from the beginning of X3.2 work in 1960.

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American Standard Code for

Information Interchange

1. Scope

This coded character set is to be used for the general interchange of information among information processing systems, communication systems, and associated equipment.

2. Standard Code

			b_7	0	0	0	0	1	1	1	1
			b_6	0	0	1	1	0	0	1	1
			b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1								
0	0	0	0	NULL	DC$_0$	␢	0	@	P	UNASSIGNED	UNASSIGNED
0	0	0	1	SOM	DC$_1$	!	1	A	Q		
0	0	1	0	EOA	DC$_2$	"	2	B	R		
0	0	1	1	EOM	DC$_3$	#	3	C	S		
0	1	0	0	EOT	DC$_4$ (STOP)	$	4	D	T		
0	1	0	1	WRU	ERR	%	5	E	U		
0	1	1	0	RU	SYNC	&	6	F	V		
0	1	1	1	BELL	LEM	' (APOS)	7	G	W		
1	0	0	0	FE$_0$	S$_0$	(	8	H	X		
1	0	0	1	HT/SK	S$_1$	)	9	I	Y		
1	0	1	0	LF	S$_2$	*	:	J	Z		
1	0	1	1	V$_{TAB}$	S$_3$	+	;	K	[		
1	1	0	0	FF	S$_4$	, (COMMA)	<	L	\		ACK
1	1	0	1	CR	S$_5$	—	=	M	]		①
1	1	1	0	SO	S$_6$	•	>	N	↑		ESC
1	1	1	1	SI	S$_7$	/	?	O	←		DEL

3. Positional Order and Notation

Standard 7-bit set code positional order and notation are shown below with b_7 the high-order, and b_1 the low-order, bit position.

	b_7	b_6	b_5	b_4	b_3	b_2	b_1
EXAMPLE: The code for "R" is:	1	0	1	0	0	1	0

4. Legend

NULL	Null/Idle	DC$_1$-DC$_3$	Device control
SOM	Start of message	DC$_4$(Stop)	Device control (stop)
EOA	End of address	ERR	Error

Legend continued on following page

Legend Continued

EOM	End of message
EOT	End of transmission
WRU	"Who are you?"
RU	"Are you . . .?"
BELL	Audible signal
FE$_0$	Format effector
HT	Horizontal tabulation
SK	Skip (punched card)
LF	Line feed
VTAB	Vertical tabulation
FF	Form feed
CR	Carriage return
SO	Shift out
SI	Shift in
DC$_0$	Device control reserved for data link escape

SYNC	Synchronous idle
LEM	Logical end of media
S_0-S_7	Separator (information)
ƀ	Word separator (space, normally non-printing)
<	Less than
>	Greater than
↑	Up arrow (Exponentiation)
←	Left arrow (Implies/ Replaced by)
\	Reverse slant
ACK	Acknowledge
①	Unassigned control
ESC	Escape
DEL	Delete/Idle

Note: Expanded definitions of some of the above terms may be found in the appendixes.

5. Qualifications

5.1 This standard does not define the means by which the coded set is to be recorded in any physical medium. The standard code does not include any redundancy or define techniques for error control. Further, it does not specify a standard collating sequence.

5.2 Deviations from the standard may create serious difficulties in information interchange and should be used only with full cognizance of the parties involved.

5.3 Unassigned codes are reserved for future standardization. Their use in information interchange prior to such standardization is a deviation from the standard.

5.4 The appendixes to this standard cover code design considerations and criteria, related subsets, extensions and deviations.

Appendixes

(These Appendixes are not a part of American Standard Code for Information Interchange, X3.4-1963, but are included to facilitate its use.)

Appendix A
Design Considerations for the Coded Character Set

A1. Introduction

A1.1 The standard coded character set is intended for the interchange of information among information processing systems, communication systems, and associated equipment.

A1.2 Work will continue in the following areas (not necessarily listed in order of priority):

(1) Representation of the coded character set in the principal media (perforated tape, magnetic tape, and punched cards)
(2) Error control considerations
(3) Collating conventions
(4) Relation of the standard set to other sets
(5) Assignment of meaning to presently unassigned codes as required
(6) Relationship to other standards

A2. Considerations Affecting the Standard

There were many considerations that determined the standard's set size, set structure, character selection, and character placement. Among these were (not listed in order of priority):

(1) Need for adequate number of graphics
(2) Need for adequate number of device controls and format effectors
(3) Desire for a non-ambiguous code, i.e., one in which every character has a unique meaning independent of other characters
(4) Physical limitations of media and facilities
(5) Error control
(6) Special interpretation of the all-zeroes and all-ones codes
(7) Ease in the identification of classes of characters
(8) Data manipulation requirements
(9) Collating conventions
    (a) Logical
    (b) Historical
(10) Keyboard conventions
    (a) Logical
    (b) Historical
(11) Other set sizes
(12) International considerations
(13) Programming languages
(14) Existing coded character sets

A3. Set Size

A 7-bit set is the minimum size that will meet the requirements for graphics and control in applications involving general information interchange. Both a 6-bit and an 8-bit set were considered and rejected—the 6-bit, providing only 64 graphics, could not accommodate essential format effectors, such as "carriage return," "line feed," "horizontal tab," etc; the 8-bit because it provides far more characters than are now needed in general applications.

A4. Set Structure

A4.1 In discussing the set structure it is convenient to divide the set into 8 columns of 16 characters each, as indicated in the standard.

A4.2 It was considered essential to have a dense 64-character subset which contained only graphics. For ease of identification this graphic subset was placed in 4 contiguous columns.

A4.3 Placement of the graphic subset was dictated by the requirement that the all-zeroes character be reserved for the "Null/Idle" function, and the all-ones character for the "Delete/Idle" function. Since the first and last columns contain these characters, the next logical choice for the graphic subset was the middle four columns of the code. Although this placement complicates the identification of the graphic subset since two bits must be examined (a one-bit test would have been sufficient had these graphics been placed in the first four or last four columns), this disadvantage is outweighed by the advantages of the dense graphic subset.

A4.4 The character set was structured to enable the easy identification of classes of graphics and controls.

A5. Choice of Graphics

Included in the set are the digits, a single case of the alphabetic letters A through Z, and those punctuation, mathematical, and business symbols considered most useful. The set includes the characters commonly encountered in programming languages. In particular, the COBOL graphics are included. It is not practicable to include all of the ALGOL graphics (which number 120).

A6. Graphic Subset Structure

A6.1 The basic structure of the dense graphic subset was influenced by logical collating considerations, the requirements of simply related 6-bit sets, and the needs of typewriter-like devices. For information processing, it is desirable that the characters be arranged in such a way as to minimize both the operating time and the hardware components required for ordering and sequencing operations. This requires that the relative order of characters, within classes, be such that a simple comparison of the binary codes will result in information being ordered in a desired sequence.

A6.2 Conventional usage requires that the word separator (space) be ahead of any other symbol in a collatable set. This permits a name such as "Johns" to collate ahead of a name such as "Johnson." The requirement that punctuation symbols also collate ahead of the alphabet ("Johns, A" should also collate before "Johnson") established the special symbol locations, including space, in the first column of the graphic subset.

A6.3 To simplify the design of typewriter-like devices, it is desirable that there be only a common 1-bit difference between characters normally paired on keytops. This, together with the requirement for a contiguous alphabet, the collating requirements outlined above, and international considerations, resulted in the placement of the alphabet in the last two columns of the graphic subset. This left the second column of the graphic subset for the numerals.

A6.4 Although the resultant structure of "specials" (S), "digits" (D), and "alphabetics" (A) does not conform to the most prevalent collating convention (SAD), it must be recognized that simple binary rules for collation do not necessarily apply between classes of characters.

A6.5 The need for a simple transformation from the set sequence to the prevalent collating convention was recognized, and dictated the placement of some of the "specials" within the set. Specifically, those special symbols, viz, ampersand (&), asterisk (*), comma (,), hyphen (-), period (.), and slant (/), which are most often used as identifiers for ordering information and which normally collate ahead of both the alphabet and the numerals, were not placed in the column containing the numbers, so that the entire numeric column could be rotated via relatively simple computer logic to a position higher than the alphabet. The sequence of the aforementioned "specials" was also established to the extent practical to conform to the prevalent collating convention.

A6.6 The need to adapt a useful 4-bit numeric set from the 6-bit graphic subset also played a role in the placement of characters. Such a 4-bit set, including the digits, asterisk, plus (+), comma, hyphen, period, and slant, can easily be derived from the standard.

A6.7 To further international standardization, and provide the 4-bit set mentioned in A6.6, the structure of the graphic subset precludes (logically) the historic keyboard association of colon (:) with semicolon (;). However, the dual character key assignment of the question mark (?) with the slant was maintained, as it was with a majority of the numerals and commonly associated symbols.

A6.8 Considerations of other domestic code sets, including the Department of Defense Standard 8-bit data transmission code (1961) as well as international requirements, played an important role in deliberations that resulted in the standard. The selection and grouping of the symbols dollar sign ($), percent sign (%), ampersand, and apostrophe (') and the symbols less than (<), equal (=), and greater than (>) permit contraction to either a business ($ % &) or scientific (< = > ') 6-bit subset. The sequence of these latter symbols and of the symbols comma, hyphen, period, and slant permitted an advantageous pairing on the keyboard. The historic pairing of question mark and slant is preserved and the less than and greater than symbols, which have comparatively low usage, are paired with period and comma so that in dual-case keyboard devices where it is desired to have period and comma in both cases the less than and greater than symbols are the ones displaced. Provision was made for the accommodation of alphabets containing more than 26 letters and for 6-bit contraction by the location of low-usage characters in the area following the alphabet. In addition, the requirement for the digits 10 and 11 used in sterling monetary areas was considered in the placement of the asterisk, plus, semicolon, and colon.

A7. Choice of Controls

A7.1 The control characters included in the set are those required for the control of terminal devices, input and output devices, format, or transmission and switching on a general enough basis to justify inclusion in a standard set.

A7.2 A group of eight codes has been reserved for information separators which when implemented in a system shall bear a hierarchical relationship. They identify boundaries of various elements of information.

A7.3 Information separators are machine-oriented controls having two characteristics that differentiate them from human-oriented separators (word separator, punctuation, etc). First, machine-oriented separators are hierarchical in nature, whereas human-oriented separators have no fixed hierarchy. Second, machine-oriented separators must serve rigidly defined functions in a system, whereas proper interpretation of human-oriented separators requires knowledge of the context in which they are used.

A8. Control Subset Structure

A8.1 The first two columns were chosen for most of the assigned controls because there are more codes in the last two columns with a high probability of being inadvertently generated during an idle line condition than there are in the first two columns. "Acknowledge" was placed where its code could be generated by simple means. The "Escape" was placed so as to conform with the "special" function of the DOD standard 8-bit code and to facilitate the 6-bit contraction.

A8.2 The controls that were selected logically fall into four groups:

(1) Transmission controls
(2) Format effectors
(3) Device controls
(4) Information separators

Within each group the controls are ordered so that the binary and hierarchical order are directly related. This structure facilitates the contraction of the standard to related 6-bit sets and permits logical comparisons of related controls in the ordering of information. In particular, the placement of the format effectors and information separators facilitates their dual usage when contracting to a related 6-bit set.

Appendix B

Related Subsets and Adaptations

B1. Introduction

B1.1 The standard code was developed to provide for information interchange among information processing systems, communications systems, and associated equipment. Its structure facilitates conversion from the standard code to adaptations usable internally in a variety of equipments. In a system consisting of several equipments each with its local or native code, maximum flexibility will be achieved if each of the native codes is translated to the standard whenever information interchange is desired.

B1.2 Within any particular equipment or closed system it may be necessary to substitute characters. For example, some systems may require special graphic symbols and some devices may require special control codes. Design efforts on the standard code included consideration of these types of adaptations and the possibility that the parties employing them may develop a need to interchange information with others. If certain simple rules are followed in making such adaptations, minimum difficulty will be encountered in conversion to the standard code.

B1.3 The material below describes possible adaptations and logically related sets.

B2. Character Substitutions

B2.1 When a nonstandard character is introduced, only the code position where the substitution is made shall be affected.

B2.2 It is recommended that graphic substitutions be made only in the graphic area and control substitutions only in the control area. Any substitution involving a control should be made only with full cognizance of all possible operational effects.

B2.3 Any such substitution will result in a nonstandard coded character set.

B3. Unassigned Codes

A meaning was not assigned to a code unless that meaning was of sufficiently general use to warrant standardization. This resulted in some codes being unassigned. These codes are subject to future standardization. Where an unassigned code is given meaning in a particular system, such meaning is nonstandard and use of this code in information interchange is hazardous.

B4. Illustrative Nonstandard Codes

Code sets obtained by modifying the standard as shown below, or by other replacements, are nonstandard.

B4.1 European Alphabets. The five graphics immediately following the letter Z can be replaced by the additional letters required for complete expression of certain European alphabets. Further, the single position preceding the letter A can be used for those alphabets requiring 32 characters. In most cases, only three additional letters will be required.

B4.2 Base 12 Numeric Digits. For those applications requiring use of the sterling monetary system or duodecimal arithmetic, the digits 10 and 11 can replace the two graphics immediately following the digit 9.

B5. Related Larger and Smaller Sets

Consideration has been given to the relationship between the standard set and sets of other sizes. A number of straightforward logical transforms are possible which result in a variety of sets related to the standard. None of the transformed sets should be considered standard.

Appendix C

Specific Criteria

C1. Introduction

C1.1 This Appendix contains the criteria on which the design of the code was based. Not all criteria have been entirely satisfied. Some are conflicting, and the characteristics of the set represent acceptable compromises of these divergent criteria.

C1.2 The standard has been designated a code for information interchange and not necessarily for internal use in information processing equipment. However, many of the criteria used in establishing the set are processor-oriented since simplicity in deriving logical and consistent processing sets was considered mandatory.

C2. Criteria

C2.1 All codes in the set shall consist of the same number of binary positions (bits).

C2.2 The standard set shall be so structured as to facilitate derivation of larger or smaller sets.

C2.3 Each character code shall consist of n binary bits. All possible 2^n combinations of ones and zeroes will be permitted and considered valid.

C2.4 The number of bits, n, shall be sufficient to provide for the alphabetic and numeric characters, commonly encountered punctuation marks, and other special symbols, along with those controls required for interchange of information.

C2.5 The numerals 0 through 9 shall be included in a 4-bit subset.

C2.6 The numerals 0 through 9 shall be so coded that the four low-order bits shall be the binary-coded-decimal form of the particular numeral that the code represents. In the selection of the two characters immediately succeeding the numeral 9, consideration shall be given to their replacement by the graphics 10 and 11 to facilitate the adoption of the code in the sterling monetary area.

C2.7 The interspersion of control codes among the graphic codes shall be avoided. The codes devoted to controls shall be easily separable from those devoted to graphics.

C2.8 Within the standard set, each character and its corresponding code shall stand by itself and not depend on surrounding characters for interpretation. The "mode shift" characters (SO, SI, or Escape) in an information stream shall signal a departure from the standard set.

C2.9 The alphabet A through Z shall be included in a 5-bit subset. Consideration shall be given to the need for as many as 32 characters in some alphabets.

C2.10 With the letters of the alphabet in their conventional order, A through Z, the codes shall be assigned in continuous increasing binary order. This criterion prevents interspersion of non-alphabetic characters within the alphabet.

C2.11 Suitable control codes required for communication and information processing shall be included.

C2.12 Escape functions that provide for departures from the standard set shall be incorporated.

C2.13 A simple binary comparison shall be sufficient to determine the order within each class of characters. (For the purpose of this standard, the special graphics, the numerals, and the alphabet are each defined as distinct classes.) Simple binary rules do not necessarily apply between classes when ordering information.

C2.14 The "word separator" (i.e., the space between words) must collate ahead of all other graphics.

C2.15 Special symbols used in the ordering of information must collate ahead of both the alphabet and the numerals.

C2.16 Insofar as possible the special symbols shall be grouped according to their functions; for example, punctuation, mathematical symbols, and shorthand abbreviations. Further, the set shall be so organized that the simplest possible test shall be adequate to distinguish and identify the basic alphabet, numeric, and special symbol subsets.

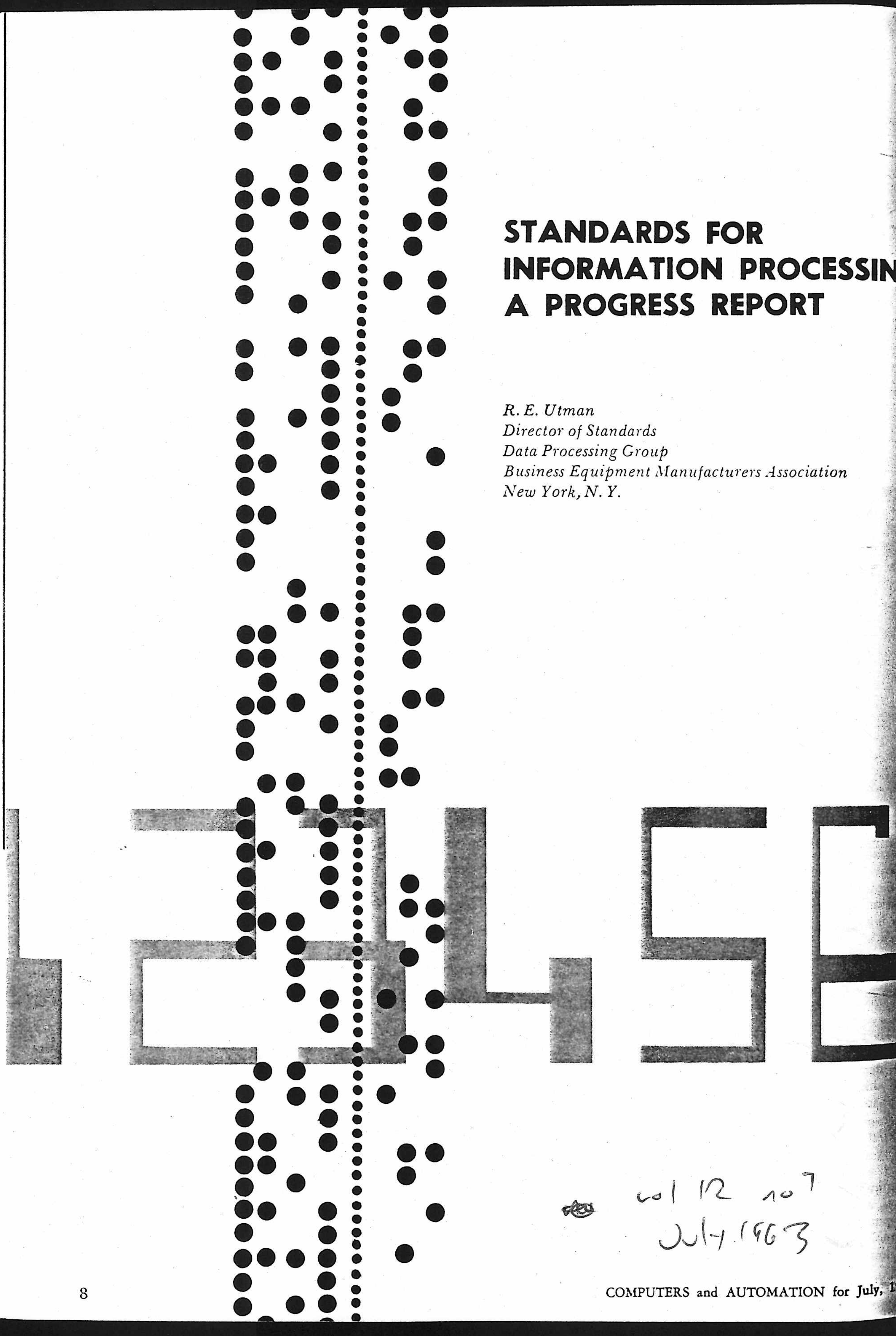
C2.17 Special symbols shall be placed in the set so as to simplify their generation by typewriters and similar keyboard devices.

This criterion means, in effect, that the codes for pairs of characters that normally appear on the same keytops on a typewriter shall differ only in a common single-bit position.

C2.18 The set shall contain the graphic characters of the principal programming languages.

C2.19 The codes for all control characters shall contain a common, easily recognizable, bit pattern.

C2.20 The null, idle, and delete control functions shall be provided.



STANDARDS FOR INFORMATION PROCESSING: A PROGRESS REPORT

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Director of Standards
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New York, N. Y.

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July 1963

Probably no subject in the computer field has stimulated as much discussion and controversy in the past year as "standards." The author, who guides standards work for the association of computer manufacturers, presents a comprehensive review and projection of current activity in the development of standards for information processing.

The data processing industry developed through the 1950's without the discipline of standardization. Although this led to today's stiff competition which has rapidly given the user more and more for his dollar, it also entailed many headaches and increased unnecessary costs both for him and the manufacturer, such as these:

1. Representation of data by different code sets caused files to be ordered in different ways and reports to change format when different computers were used.
2. Incompatibility of magnetic tapes has caused manufacturers to [illegible] and produce, and users to [illegible] for. converters which could have been eliminated altogether in a more disciplined framework.
3. The re-programming problem has made it expensive and time-consuming to switch from one computer to a better one with different logic.

The time was right, then, in 1960 for standardization, particularly of glossary, character sets and codes, languages, and input-output media, for the exchange of information between information processing equipments and humans. For this reason, the American Standards Association (ASA) and the International Organization for Standardization (ISO) decided in 1960 to form committees nationally (X3) and internationally (TC 97) on Computers and Information Processing, whose scopes:

> "Standardization of terminology, problem description, programming languages, and communication characteristics of computers and information processing devices, equipments and systems."

were adopted in organization meetings held in 1960 and 1961. ISO assigned the Secretariat of TC 97 to the United States and the ASA, which in turn recognized the Business Equipment Manufacturers Association (BEMA) as sponsor of X3 and TC 97, with X3 to develop proposed draft standards both for the U. S. and the world.

Nearly simultaneously with the ISO formation of TC 97, the International Electro-Technical Commission (IEC) decided to form TC 53 to propose standards related to the electrical characteristics of Information Processing Equipment. The IEC also assigned the Secretariat for this work to the USA, and the ASA-US National Committee of the IEC selected the Electronic Industries Association (EIA) as sponsor, and formed Sectional Committee X6 to handle this work nationally. The scope of X3 was then clarified so as to include standards of a logical and physical or non-electrical nature. Also formed in 1960-61 were ISO/TC 95 and X4 on Office Machines standards, including the input-output media of such. The Office Machine Group of BEMA was selected as sponsor; to coordinate work of common interest among these bodies, joint steering committees were finally created at the national and international levels.

Optical Character Recognition

In order to break its work down into pieces of manageable size, X3 has seven working subcommittees. The first of these is X3.1 on Optical Character Recognition (OCR). As an example of the amount of work going into the formulation of information processing standards, X3.1 has met twenty-two times in its less than three years of existence. Furthermore, it has Task Groups on Font Development, Printing, and Applications. These Task Groups have met approximately as many times as X3.1 itself. During its last year of work, X3.1 has made much progress in selecting a numeric font for which to develop specifications (principally the decimal digits and a few special OCR characters) for a proposed American and ISO standard. There has recently been much discussion as to whether there should be a numeric standard followed later by a compatible alphanumeric proposal, or the ultimate alphanumeric font as the first OCR standard. It was decided in the January-March 1963 meetings to recommend the numeric first. X3.1 is trying to complete its draft numeric proposal by the end of 1963. They have had to move very carefully because a less than rigorous subjective proposal would not be acceptable, or, if adopted, would cost some manufacturers heavily. A good standard, on the other hand, would be a fundamental to the OCR business, on which it may then move forward. OCR is a good example of a situation where a balance must be achieved between the choice of optimum parameters for two interrelated sets of hardware: in this case the imprinter and the reader. It will probably be mid-1964 before the subsequent draft standards are proposed for the letters and other characters.

Bank Check Specifications

Closely related to the work of X3.1, Optical Character Recognition, is the work done by X3.7 which assumed the work of the Office Equipment Manufacturers Committee in conjunction with the American Bankers Association on MICR (magnetic ink character recognition). In September 1962, X3.7 presented to X3 two proposed American standards on Print and Bank Check Specifications for Magnetic Character Recognition. Since these had already been adopted by the American Banking Association and had become de facto practices, they were approved unanimously by X3 and submitted to ASA for processing. A patent application by a manufacturer on the print specifications has since come to light, however, placing the two proposals in suspense until agreements are obtained to place the techniques in the public domain. Over six months have gone by and the agreements have yet to be reached, but it is hoped now that they will be reached shortly.

Internationally, the European Computer Manufacturers Association (ECMA) TC-4 and the European Bankers Association (EBA) are carrying out similar work in parallel to X3.1 and X3.7. It is hoped that ISO/TC 97/SC 3—Character Recognition—will compare the X3.1 work with the ECMA TC-4 work on a numeric and subsequent alphanumeric font before proposing any international draft recommendation. X3.1 is also starting to work more closely with ECMA TC-4, though participation in their bi-monthly working parties is expensive liaison.

In MICR, the French proposal CMC-7, based on BULL equipment, has recently been adopted by the EBA as a European Common Market standard in preference to the proposed American Standards. This work assures multiple ISO standards, rather than the immensely desirable goal of a single international standard.

Character Sets and Data Formats

In the basic technology of Character Sets and Data Formats, X3.2 from its inception took as its main goal the realization of an American Standard coded character set for the exchange of information between information processing (IP) systems and between IP systems and associated equipment. Using a 19-point set of criteria, the Subcommittee presented a 128-character set (not all characters assigned as yet) to X3 in November 1961 in the form of a proposed American standard. The proposal was accompanied by several appendices which show the design considerations and criteria which led to the set and describe related sets and adaptations.

The proposed set is not the same as any of the many sets already in use, nor could it be. Compelling reasons dictated various changes to existing practices. Here are just a few of the many design considerations which were used:

Set Size: Need for letters: digits; programming language characters of COBOL and ALGOL; data processing characters like @, $, %; transmission characters like null/idle, delete/idle, "Who are you," start of message; carriage control characters like bell, carriage return, horizontal tab. It was decided that 128 was a reasonable set size, requiring a 7-level binary coding scheme.

Collation Sequence: Although no collation sequence is specified, much effort was devoted to requirements of ordering, a few of which are: digits should be consecutive, letters should be consecutive, "Johns" should collate ahead of "Johnson," control characters should collate together, where possible the upper case—lower case arrangement of characters on a typewriter should correspond to a single bit difference between characters of such a pair, etc.

International Considerations: Provision was made for expansion of the alphabet.

Dissent

During much of 1962, dissenting papers were considered, resulting in minor changes to the proposal and rebuttals by X3.2. Then on September 14, 1963, X3 voted to submit a proposed draft standard to ASA. X4, however, voted against this draft standard as inappropriate for office machines use. BEMA, as sponsor of X3 and X4 recommended delay in submission to ASA until representations of the code in the principal media of punched cards, perforated tape and magnetic tape could also be proposed. In January 1963, however, X3 approved immediate submittal to ASA, and the code standard was formally submitted to ASA. The ASA Miscellaneous Standards Board has since approved it as an American Standard, and as a final step the ASA Standards Council is now reviewing all aspects of its development and processing. It is expected to become a Standard of fundamental significance shortly.

Future work by X3.2 in 1963 and later will include expansion and elaboration of the originally adopted set, resulting in draft proposals for its representation in the principal media. A perforated tape proposal is expected to be available to X3 in three months, magnetic tape in nine months or less, and punched cards in mid-1964.

International Character Set

Internationally, the TC 97/Subcommittee 2 corresponding to X3.2, proposed at its October 1962 Paris meeting that its 6- and 7-level coded character set (whose 7-level is almost identical with that of X3.2, if you interpret $ as a special case of the general currency symbol) be distributed as a draft proposal for an international standard. It also plans to work on the representation of the coded set in the various physical media, beginning at a Fall 1963 meeting.

Digital Data Transmission

In digital data transmission standards work, there is considerable overlap between X3.3 and EIA's TR-27.3. To avoid wasteful duplication, the two groups have been holding joint meetings. X3.3 has created six Task Groups to reflect its current work and objectives: Liaison, Glossary, Data Transmission Formats, End-to-End Control Characteristics, System Performance, Digital Data Transmission Speeds. In June of 1962, it presented X3 with a proposed American Standard on Signaling Speeds for Data Transmission, which cleared promptly through X3, BEMA and ASA and, on August 8, 1962, became the first American Standard in the Information Processing field. It is now being circulated internationally by ISO/TC 97/SC 6 for vote as a draft Future Guides on Signaling Speeds of Data Transmission, to be available as such to the ISO-IEC mailing list, including the International Telegraph and Telephone Consultative Committee (CCITT), which claims pre-eminence in this special field of international standardization.

Programming Languages

As an important area for standardization, programming languages (X3.4) are certainly among the most difficult. Reflecting the common User desire for such standardization, three languages, which are to some extent machine independent, have realized wide national and to some extent international recognition: FORTRAN, COBOL and ALGOL. FORTRAN, originally designed for one machine, became so useful that it has been implemented for about 50 machine types. Needless to say, partly because of different machine parameters (memory size, numbers of tape transports, etc.), partly because the original standardizing body SHARE was set up for a single machine family, there is tremendous variation in these various FORTRANS. Only with FORTRAN is the body of American usage experience significant. COBOL, and to a less extent ALGOL, are as yet too young. Nevertheless, there are also about 50 compilers for each of them, and ALGOL is achieving wide usage as a standard language for the publication of algorithms. Much experience for these compilers and languages will become available during 1963 and 1964.

Task Groups

X3.4 is addressing itself, with great respect for the difficulty of the task, to the job of standardizing Programming Languages. It has several Task Groups. The first, X3.4.1, has the function of specifying how to specify a language. A paper by its Chairman, Saul Gorn, illustrates the variety of approaches that could be used. Recently, progress has been made toward solution of the problem of recognizing ambiguities and inconsistencies in languages. This is not a trivial problem. The second, X3.4.2, is charged with reviewing draft standards proposed by other X3.4 subcommittees for completeness and acceptability, and also for establishing USA positions in regard to ALGOL. X3.4 recently reaffirmed its desire that the USA support ALGOL first as a potential international standard, and when and if the need arises to propose

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AMERICAN
CHART OF PROGRESS

X3 SC-	Proposed American Standard	Date of X3 Working Group Devel.	Date of X3 Working Group Complete Draft	Dates of Approval By SC-	X3	Sponsor	ASA Standards Board	ASA	Abbrev. Title pAS-
X3.1	OCR Numeric Font, Print Specifications	62-63	12/63	12/63	4/64	5/64	7/64	8/64	NFOCR
X3.1	OCR Alphanumeric Font, Print Specifications	62-64	Late '64						
X3.2	Code for Information Interchange	61-62	11/61	11/61	1/63	3/63	4/63	5/63	CII
X3.2	Addenda to the pASCII--								
X3.2	Extension Rules (Escape)	62-63	6/63	8/63	10/63				CII_{Rev-E}
X3.2	Controls, Definition of	63	6/63	6/63	10/63				CII_{Rev-C}
X3.2	Subsets, Related	63	8/63						CII_{Rev-S}
X3.2	Unassigned Area, Use of	63	8/63						CII_{Rev-U}
X3.3	Controls for Synchronous Data Transmission	63	8/63						CII_{Rev-CS}
X3.2	Input-Output Media--								
X3.2	Perforated Tape Code	62-63	5/63	6/63	10/63				PTC
X3.2	" " Physical - Dimensional Spec's (1")	60-63	6/63	8/63	10/63				PTS-1"
X3.2	" " " " " (11/16")	60-63	6/63	8/63	10/63				PTS-11/16"
X3.2	Magnetic Tape Code	62-63	10/63	12/63					MTC
X3.2	" " Physical-Dimensional Spec's (1/2")	60-63	10/63	12/63					MTS-1/2"
X3.2	Punched Card Physical-Dimensional Spec's (80 & 90 Col.)	61-63	6/63	8/63	10/63				PCS-80/90
X3.2	Edge-punched Card Physical-Dimensional Spec's	63-64							EPCS
X3.2	Punched Card Code, ASCII Direct Representation	62-64							PCC-D
X3.2	" " " , ASCII Hollerith Extension	62-64							PCC-H
X3.2	*NMTC Perforated Tape Code	60-64							NMTCCPT
X3.2	NMTC Magnetic Tape Code	63-65							NMTCCMT
X3.7	MCR (Numeric Font) Print Specifications	60-62	7/62	8/62	9/62	9/62			PSMCR
X3.7	MCR Bank Check Specifications	60-62	7/62	8/62	9/62	9/62			BCSMCR
X3.7	MCR Error Correction Techniques	63-64							$PSMCR_{Rev-E}$
X3.7	MCR Bank Check Serial Number	63-64							$BCSMCR_{Rev-S}$
X3.3	Signalling Speeds for Data Transmission	61-62	3/62	4/62	6/62	7/62	7/62	8/62	SSDT
X3.3	Data Transmission Formats	62-64							DTF
X3.3	Bit Sequencing of the ASCII (7-level)	62-63	8/62						$ASCII_{Rev-BS}$
X3.3	" " " " " Related Subsets	62-64							$ASCII_{Rev-SB}$
X3.3	Graphic Representations of Error Statistics of Rates	62-63	8/62						GPESRDT
X3.4	FORTRAN II	62-64	10/63						FORTRAN II
X3.4	FORTRAN IV	62-64	10/63						FORTRAN IV
X3.4	ALGOL	64							ALGOL
X3.4	COBOL	63-65							COBOL
X3.4	APT	63-65							APT
X3.5	Glossary for Information Processing	63-64	2/64						GIP
X3.6	Flowchart Symbols for Information Processing	61-63	3/63	5/63	8/63	10/63	11/63	12/63	FSIP

*NMTC = Numerical Machine Tool Control

INTERNATIONAL
CHART OF PROGRESS

ISO/IEC	Draft Recommendations		Date of ISO/IEC Devel.	WG Complete Draft	Dates Approved By WG	SC-	ISO/IEC Draft #1 Proposal	Draft #2 Proposal	Draft Rcmnd'n	ISO/IEC General Approval
TC97/SC 1	Glossary	Multi-lingual Vocabulary	60-64	1/64	4/64	5/64				IFIP/ICC Vocabulary
TC97/SC 2	Codes	6 and 7 Bit Coded Character Sets for Information Interchange	61-62	10/62	10/62	10/62	6/63			CCSII
TC97/SC 3	Char. Recog.	OCR Numeric Font	62-65							OCRNF
		OCR Alphanumeric Font	62-67							OCRAF
		MCR Numeric Font (E 13 B)	62-65							MCRNF
		MCR Alphanumeric Font (CMC 7)	62-66							MCRAF
TC97/SC 4	I-O Media	Punched Cards Physical-Dimensional	62-64							PCS
TC97/SC 5	Prog. Lang's	ALGOL	62-64							ALGOL
		FORTRAN	63-65							FORTRAN
		COBOL	63-66							COBOL
TC97/SC 6	Data Trans.	Guide for Future Signalling Speeds for D.T.	62-63	10/62	10/62	10/62	6/63			SS Guide
TC95/SC 8 IEC/	I-O Media	Perforated Tape, Physical-Dimensional	63-64							PTS
TC53/SC D	I-O Media	Magnetic Tape, Physical-Dimensional	63-65							MTS

the ISO standard as an American Standard ALGOL.

X3.4.3 FORTRAN was created in August [illegible] and is hard at work defining the levels of FORTRAN as a draft American Standard. Membership in X3.4.3 and its task groups is open to an Implementer and a User Group representative associated with every USA compiler. Associate membership is also available to representatives of non-USA FORTRAN compilers.

X3.4.4, COBOL, was formed in January 1963 to prepare a COBOL proposal for processing as an American standard. The COBOL Maintenance Committee of CODASYL will remain the maintenance and defining body for COBOL, whereas X3.4.4 will create test problems and prepare the specifications of the draft standard. Close coordination with CODASYL is assured through a joint steering committee, and internationally with ECMA/TC-6-COBOL through periodic meetings.

X3.4.5 is the American secretariat and delegation to TC 97/SC 5, Programming Languages. Preparations are nearing completion for the fourth meeting at the ISO/TC 97 level, to be held in June in Berlin.

X3.4.6 works on Glossary concepts in the Programming Language field.

Internationally, TV 97/SC 5 has prepared a Programming Language Survey which is now being published in professional journals, and has invited IFIP/WG 2.1 (a Working Group of the International Federation of Information Processing Societies) and X3.4 to provide draft proposals for ALGOL, FORTRAN and COBOL for consideration as international draft recommendations. It is about to conduct a depth survey on these three languages.

Glossary

In glossary work, under the new chairmanship of Martin Weik of the Department of Defense, X3.5 is working on plans to produce a proposed American standard glossary for information processing by the end of 1963. They are merging several major domestic and international vocabularies (ACM, IFIP, IRE, etc.) with the specialized glossary requirements of the other X3 subcommittees into an acceptable whole. These input definitions are punched into cards at BEMA, and the compilation process is mechanized, with merged listings resulting for X3.5 analysis. Their final recommendation, term-by-term, is then circulated to each X3 subcommittee for criticism and acceptance. For interim use by X3, the Government Interagency ADP Council Glossary has recently been approved by X3.5.

Internationally, TC 97/SC 1 has a different multi-lingual approach and objective. It recognizes the work of the IFIP-ICC glossary development effort, which proceeds by defining concepts to which specialists in each language (English, French, German, Italian) attach words. This work is rapidly gathering momentum and it appears that by May 1964 a fairly good international Information Processing vocabulary will be available. It will contain many coined words or words from one language adopted in another. X3.5 has recently formed a task group (X3.5.2) to coordinate USA participation in this IFIP/ICC effort.

Problem Description and Analysis

X3.6 on Problem Description and Analysis has devoted the last two and a half years and twenty meetings to the development of a proposed American standard flow chart symbolism for information processing, which is now about to be circulated to X3 for official vote on acceptability. The future of this subcommittee is as broad as its field of systems analysis and description. They are currently evaluating their field for the next most important need in standards.

Internationally, at the TC 97 October Paris meeting, the formation of a counterpart ISO/TC 97/WG G—Problem Definition and Analysis group was approved. It will also start by considering Flow Chart Symbol draft proposals from the Netherlands, IFIP, ECMA and the USA. No meetings have been scheduled yet.

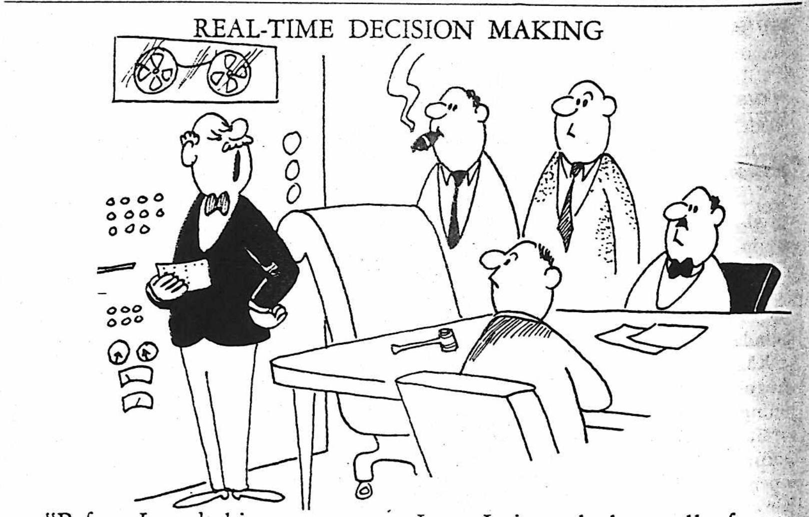
Input-Output Media

At the international level I-O media are the concern of ISO/TC 39-Machine Tools, TC 95-Office Machines, TC 97-Computers and Information Processing, and of IEC/TC 44-Electric Equipment of Machine Tools and TC 53-Computers and Information Processing. In the United States X3, X4 and X6 have been equally concerned in subcommittees X3.2, X4-A4, and TR-27.6. It is natural, therefore, that companies, countries and other interested groups who are finding it hard to man so many committees should have pressed for some simplification of the administrative procedures. The Joint Steering Committees at the national and international levels, created to solve such problems, have recommended formation of joint working groups to develop I-O media standards. These did not prove productive domestically. X3 recently recommended consolidation of X3, X4 and X6 I-O media responsibilities within X3, with the concurrence of X6, and conditioned agreement of X4. ASA then went further and assigned all I-O standardization responsibility to X3, including physical and electrical characteristics, equipment, and code representation. X3 in turn decided on May 2 to put all I-O and Codes responsibility into a reorganized X3.2, which will also be responsible for all USA participation in the numerous international working groups and subcommittees mentioned previously. It is hoped that this remarkable and rare opportunity for consolidation and simplification just experienced nationally can next be extended to the international level.

The new X3.2 is immediately confronted with processing draft American and international proposals for physical-dimensional standards in perforated tape, magnetic tape, and punched cards, and for numerically controlled machine tool punched tape code, resultant from four previous years of EIA and joint working group development. This processing and evaluation work will be undertaken as soon as qualified engineering becomes available within the membership of the new X3.2. Participation in several international working group meetings later this year must also be immediately organized, with delegates and USA positions or proposals provided.

Process Control

The scope of X3 was expanded formally in January 1963 to include responsibility for standards in the field of process control, including numerical machine tool control. X3 membership is in the process of expansion to include six new members from this industry and its users and general interests. X3.2 is expanding its membership to enable processing code and media requirements in process control systems. X3.4 has already begun a study project on the potential of APT (Automatically Positioned Tool) as a standard programming language for machine tool applications. This new X3 responsibility is expected to influence all subcommittees, and eventually require new groups for specialized needs.



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A PRIMER ON STANDARDS AND THE GROUPS PROPOSING THEM

Although the call for "standards" has been reaching increasing volume during the last several months, many people are still unaware of what standards are, who writes them, and how they are reviewed, accepted, or rejected. Below is an outline of the groups active in standards for information processing in this country, the subjects they are working on, and their membership.

The American Standards Association (ASA) is a privately supported organization acting as the national clearinghouse and coordinating agency for voluntary standards in the United States.

ASA is a federation of 138 trade associations and professional societies. Over 2,000 companies are sustaining members.

ASA's main functions are:

1. To provide systematic means for the development of American Standards
2. To promote the development and use of national standardization in the United States
3. To approve standards as American Standards provided they are accepted by a consensus of all national groups substantially concerned with their scope and provisions
4. To coordinate standardization activities in the United States
5. To serve as a clearinghouse for information on American and foreign standards
6. To represent American interests in international standards work

More than 2,000 American Standards have been developed and approved under ASA procedures. These standards apply in the fields of engineering, industry, safety, and consumer goods.

HISTORY

In 1918 five leading American engineering societies decided to form a national organization that could coordinate the development of national standards, founding the "American Engineering Standards Committee"—the forerunner of the American Standards Association. Three departments of the federal government, Commerce, War, and Navy, joined the organization as founding members.

In 1928 the American Engineering Standards Committee was reorganized and renamed the American Standards Association (ASA).

In 1948 ASA was incorporated under the laws of the State of New York. A Board of Directors is responsible for policy, administration and financial matters. A Standards Council, representing all member-bodies, supervises all technical activities and determines the over-all standards policy.

About 400 standards projects are currently active. Approximately 10,000 engineering, government officials, and representatives of various national groups are participating in these projects.

AMERICAN STANDARDS

An American Standard is a voluntary national standard, arrived at by common consent, and available for voluntary use.

It is a standard approved by the American Standards Association. Because ASA's procedures are based upon the principle of consensus from the initiation of work to its conclusion, an American Standard is accepted as the one national authoritative standard in its immediate field of application.

An American Standard can be developed by a committee set up under the auspices of the American Standards Association.

Also, trade associations and professional societies which have developed their own standards can submit these to ASA for approval as American Standards.

Approval of a standard as "American Standard"—no matter how or where developed—is given only if the standard is supported by a consensus of all national groups substantially concerned with its scope and provisions.

INTERNATIONAL STANDARDIZATION

The American Standards Association holds the U. S. membership in two international standardization bodies—International Organization for Standardization (ISO), International Electrotechnical Commission (IEC)—and the Pan American Standards Committee (PASC). In this way, ASA provides the channel through which American interests can participate in global and hemispheric standards projects. ASA also works with the British Standards Institution and the Canadian Standards Association through the "ABC" (American-British-Canadian) Conference on Unification of Engineering Standards.

The ASA library is a source of information on thousands of foreign standards. The Association supports U. S. foreign trade by promoting a knowledge of American Standards abroad.

HOW AMERICAN STANDARDS ARE ACHIEVED

American Standards come into existence through three basic methods.

1. Section Committee Method. A committee, composed of representatives accredited for the purpose by all groups and organizations substantially concerned with the scope of the standards project and organized under the rules of ASA for such committees, formulates the standard. The special utility of the method consists in the provision, in advance, of such representation that a consensus will be assured and self-evident when the members have approved their completed assignment.

2. Existing Standards Method. Under this method, an existing standard may be submitted for approval by any responsible body, and may be approved by ASA provided:

(a) It is shown that the standard is supported by the necessary consensus of those substantially concerned with it
(b) It does not conflict with any other American Standard

Approximately one third of the standards approved by ASA have been considered under this method.

3. General Acceptance Method. Comparatively simple standards that do not require prolonged committee work can be approved at a General Conference of all groups vitally concerned with the scope of the standard. The conference action is finalized through letter ballot action to establish the existence of the consensus required for approval by ASA.

ASA SECTIONAL COMMITTEE METHOD

The Sectional Committee Method, one of the methods recognized by ASA Procedure as meeting the basic requirements of the Association, consists in the formation, at the beginning of a project, of a committee to develop one or more standards under an assigned scope. The committee is composed of representatives accredited for the purpose by the various organized groups concerned with the project and, when desirable, companies and specially qualified individuals as general interests. Membership in a sectional committee may also be in the name of the organization as such, no individual being designated as representative or alternate.

ASA is prohibited by its constitution from formulating standards. It is not a technical society engaged in standardization work. It therefore cannot own any committees that formulate standards. Thus sectional committees can only be considered as belonging to the group of organizations having representation on the committee and which have agreed to cooperate, under ASA procedure, in the development of standards they all desire.

ASA SECTIONAL COMMITTEE SPONSOR

One or more organizations principally concerned with the work assigned to a sectional committee may be designated to give administrative support and direction to the committee. The sponsor organization is responsible for the administration and direction of the standards project. It organizes the sectional committee with the advice and assistance of ASA; it ensures that the work is carried out continuously and effectively; it provides the necessary administrative services; and keeps ASA informed on the progress of the work. A project may have more than one sponsor.

X3 SECTIONAL COMMITTEE

X3 TITLE—COMPUTERS AND INFORMATION PROCESSING

X3 SCOPE—

Standardization of the terminology, problem description, programming languages, communication characteristics (1), and physical (non-electrical) characteristics (2), of computers and data processing devices, equipments and systems (3).

Note 1. Includes standardization of symbology, coded character sets and representations, input/output media and formats, character recognition.

Note 2. Includes standardization of the logical and physical characteristics.

Note 3. Includes process control systems and others as developed.

X3 MEMBERSHIP

Membership is by national association, society or organization, divided equally into three groupings by interest:

General Interest Organizations,
Manufacturer Associations,
User Organizations.

The following organizations are regular voting members of X3:

GENERAL INTEREST GROUP

(10 Votes)

American Institute of Electrical Engineers
Association for Computing Machinery
Association of Consulting Management Engineers
American Management Association
Data Processing Management Association
Department of Defense
Electronic Industries Association
Engineers Joint Council
Institute of Radio Engineers
Telephone Group

MANUFACTURER GROUP (10 Votes)

*Business Equipment Manufacturers Association

USER GROUP (9 Votes)

American Bankers Association
American Gas Association & Edison Electric Institute
American Petroleum Institute
Air Transport Association
General Services Administration
Insurance Accounting & Statistical Association
Joint Users Group
Life Office Management Association
National Retail Merchants Association

*At present one association, BEMA, represents the interests of manufacturers in X3. The ten votes of BEMA are held by ten member companies, selected annually, and including:

Burroughs Corporation
International Business Machines Corp.
Minneapolis-Honeywell Regulator Co.
Monroe Calculating Machine Co.
National Cash Register
Pitney-Bowes, Inc.
Radio Corporation of America
Remington Rand Division of Sperry Rand
Royal McBee Corporation
Standard Register Company

X3 OFFICERS

Chairman, C. A. Phillips, BEMA
Secretary, R. E. Utman, BEMA

X3 SUBCOMMITTEES

X3 has organized into seven subcommittees, responsible for the technical work of considering and providing for the initial standardization requirements of information processing:

X3.1—Optical Character Recognition
X3.2—Coded Character Sets and Data Formats
X3.3—Data Transmission
X3.4—Common Problem-Oriented Programming Languages
X3.5—Terminology and Glossary
X3.6—Problem Description and Analysis
X3.7—Magnetic Character Recognition

Each subcommittee has defined its range of technical responsibilities and activities in the form of scopes and programs of work approved by X3. In most subcommittees further subdivision into working groups has been necessary to the accomplishment of technical purposes (as shown below). In all subcommittees and working groups, members function as individuals rather than official representatives of organizations, although a reasonable balance of interests is desired.

X3.1 Title: Optical Character Recognition

Scope: Printed input and output to data processing systems for interchange of information between data processing and associated equipment. Humanly legible printed character sets, e.g., character recognition.

Chairman: J. J. Eachus, BEMA/Minneapolis-Honeywell
Secretary: Terrance Trickett, American Machine & Foundry Co.
USA Representative: E. Daniel Spina, BEMA/IBM
Working Groups:
X3.1.1—Font Development
X3.1.2—Printing Capabilities
X3.1.3—Format and Applications

X3.2 Title: Coded Character Sets and Data Formats

Scope: Recommendation of standards for coded character sets and recording formats (Note 1) for the interchange of information between information processing systems and between systems and associated equipment (Note 2). Such recommended standards are to include:

a. The machine sensible coded character set.
b. Such standard formats and format indicators as are required to define data fields, data records, program instructions and the like.

Note 1. Includes responsibility for the (logical) representation of codes in the several media, taking into account the need for error checking. It is recognized that media present physical limitations, and that close working liaison with other groups (I/O Media) will be necessary.

Note 2. Includes process control systems.

Chairman: L. L. Griffin, X3/DOD
Secretary: Rotates
USA Representative: John Auwaerter, Teletype Corporation
Working Groups:
X3.2.1—Code Representation/Magnetic Tape
X3.2.2—Code Representation/Perforated Tape
X3.2.3—Code Representation/Punched Cards
X3.2.4—Character Assignments/Unassigned area (pASCII)
X3.2.5—Coded Character Subsets and Applied Character Sets (related to pASCII)
X3.2.6—Definition of Control Character Functions (pASCII)

X3.3 Title: Data Transmission

Scope: Determine and define the operational characteristics governing the performance of digital data generating and receiving systems combined with communication systems.

Chairman: A. Stillman, BEMA/RCA
Secretary: E. H. Lohse, BEMA/Burroughs
USA Representative: F. Warden, BEMA/IBM
Working Groups:
X3.3.1—Liaison (EIA & CCITT)
X3.3.2—Glossary
X3.3.3—Description of Equipments
X3.3.4—Establishment of Interfaces
X3.3.5—System Performance

X3.4 Title: Common Programming Languages

Scope: Standardization of common program languages of broad utility through standard methods of specification with provision for revision, expansion, and improvement, and for definition and approval of test problems.

Chairman: R. F. Clippinger, BEMA/M-H
Secretary: K. Speierman, BEMA/Burroughs
USA Representative: H. Bromberg, BEMA/RCA
Working Groups:
X3.4.1—Language Theory
X3.4.2—Language Specifications & ALGOL
X3.4.3—FORTRAN
X3.4.4—Processor Specifications & COBOL
X3.4.5—USA in ISO/TC 97/SC 5
X3.4.6—Programming Glossary

X3.5 Title: Terminology & Glossary

Scope:

(a) To coordinate and advise the other subcommittees of ASA X3 in the establishment of definitions required for their proposed standards.
(b) To recommend to X3 a general glossary of data processing terms (for the professional community).

Chairman: Martin H. Weik, X3/DOD
Secretary: J. F. Traub, Bell Laboratories
USA Representative: J. F. Traub, Bell Laboratories
Working Groups:
X3.5.1—Definition Maintenance
X3.5.2—Glossary Advisory Committee

X3.6 Title: Problem Description & Analysis

Scope: Information Processing Problem Description and Analysis Standards to provide a systematic means of studying information processing problems, documenting, and preparing the required information for analysis.

Chairman: R. W. Green, BEMA/Standard Register
Secretary: J. W. Dresch, BEMA/UNIVAC
USA Representative: J. Pfaff, BEMA/Burroughs
Working Groups:
X3.6.1—Methodology
X3.6.2—Input/Output
X3.6.3—Data Transformation
X3.6.4—Glossary & Terminology
X3.6.5—Flow Chart Symbols

X3.7 Title: Magnetic Character Recognition

Scope:

1. Development of standards for MICR (present and future).
2. Resolution of problems which may arise in industry and the market place which involve the manufacturers and printers.

Chairman: T. M. Butler, X3/Burroughs

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y: H. Lohse, BEMA/
epresentative: F. Ward
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Establishment of Interface
Syste Performance
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Secretary: G. A. Baird, BEMA/Burroughs
USA Representative: E. Daniel Spina, BEMA/IBM
Working Group:
X3.2.1—Technical

X3 ADVISORY COMMITTEE

X3/IAC Title: X3-International Advisory Committee

Scope:
1. To ensure ce is active participation by in the working groups or subc es of ISO/TC 97.
2. To ensure that where the U. S. has the responsibility for the secretariat of working groups or subcommittees, the appropriate subcommittee of X3 is actively fulfilling its responsibilities.
3. Where there is not an exact correspondence between the scopes of ISO/TC 97 working groups or subcommittees and X3 subcommittees, to propose methods of ensuring active participation in, and representation on, TC 97 working groups or subc
4. By coordi e activities of the U. S. repres on the ISO/TC 97 working groups and/or subcommittees to formulate for approval by X3 and the DPG Engineering Committee U. S. policy and to prepare, or have prepared, the U. S. contributions or recommendations to the Plenary conferences of ISO/TC 97.
5. To propose the U. S. delegation to such Plenary conferences.
6. To participate in liaison activities with other international organizations as requested by the iat of ISO/TC 97.
7. To recomm pproval by X3 and the DPG Engi g Committee all steps that should be taken to adequately build the U. S. role in international standardization activities.

Chairman: B. W. Pollard, BEMA/Burroughs
Secretary: R. E. Utman, BEMA
Membership: USA Chairmen of ISO/TC 97 Subcommittees
SC 3—R. J. Mindlin
SC 5—R. F. Clippinger
SC 6—A. H.
USA Represent
X3 Chairman

JOINT ACTIVITY ON STANDARDS OF COMMON INTEREST

Title: National Joint Steering Committee
Scope: Provide guidance to joint standardization work of common interest among the Sectional Committees, X3, X4 and X6. Resolve jurisdictional problems.
Chairman: Rotates among chairmen of X3, X4 and X6
Secretary: Rota ecretaries of X3, X4 and X6
Membership: Chairman, Secretary, Technical Advisor of X3, X4 and X6. Miscellaneous Standards Board Sec-

/PC Title: National Joint Working Group/Punched Cards
Chairman: Charles Whitaker, NCR
Membership: EIA/TR 27.6 and ASA

/PT Title: National Joint Working Group/Punched
Chairman: F. W
Membership: E IBM
6 and ASA

/MT Title: National Joint Working Group/Magnetic Tape
Chairman: Harry Hayman, NASA
Membership: EIA/TR 27.6 and ASA

Activity on Data Transmission
meetings of ASA X3.3 and EIA/TR 27.3 are held for purposes of standards in data transmission.
Chairman: Alternates between
ASA X3.3 Chairman—A. H. Stillman, BEMA/RCA
EIA/TR 27.3 Chairman—J. L. Wheeler, Xerox

BSRB Title: BEMA Standards Review Board
Chairman: Either Director OMG or Director DPG, as indicated
Secretary: R. E. Utman, BEMA
Members: Engineering Committees of OMG and DPG

BEMA/DPG Title: BEMA/Data Processing Group
Chairman (1963): R. G. Chollar, NCR
Vice Chairman (1963): M. G. Mengel, Burroughs
Director: C. A. Phillips, BEMA
Director of Standards: R. E. Utman, BEMA
Members:
Addressograph-Multigraph Corporation
Burroughs Corporation
Farrington Electronics, Inc.
Friden, Inc.
International Business Machines Corporation
Minneapolis-Honeywell Regulator Company EDPD
Monroe Calculating Machine Company
Moore Corporation Ltd.
National Cash Register Company
Pitney-Bowes, Incorporated
Radio Corporation of America
Remington Rand Division of Sperry Rand Corporation
Royal McBee Corporation
Smith Corona Marchant, Incorporated
Standard Register Company
UARCO, Incorporated
Underwood Corporation
Xerox Corporation

BEMA/DPG-EC Title: BEMA/DPG-Engineering Committee
Chairman: C. A. Phillips, BEMA
Secretary: R. E. Utman, BEMA
Members: Representatives of Member Companies
Scope: Acts for sponsor as administrative authority for ASA X3.

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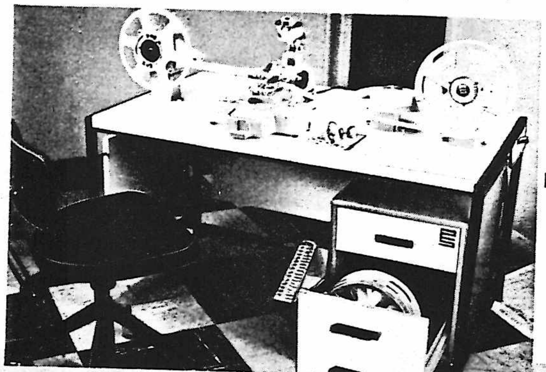

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He'll appreciate your thoughtfulness!

Copy to Mr [illegible] 7/11/63

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ROCKFORD RESEARCH

INSTITUTE INCORPORATED

140½ Mt. Auburn Street   Cambridge 38, Massachusetts   Area 617 Tel. 876-6776

July 5, 1963

7/9

Mr. John Auwaerter
Teletype Corporation
5555 Touhy Avenue
Skokie, Illinois

Dear John:

I am writing to you in regard to the "Proposed American Standard Code for Information Exchange" as presented in the document X3.2/13 dated Sept. 10, 1962, and in particular in regard to the assignment of the codes prefixed by 110 and 111 which are presently unassigned.

It is my recommendation that these codes be available for optional use as graphics for particular classes of users, in much the same fashion that figures shift on F, G, and H are now employed in the CCITT No. 2 code. For my own particular use, and for the group of users that I believe I can speak for, I would like to have the option of employing these codes for the lower case letters of the roman alphabet. In another kind of use of value to me, (with a different set of graphics) I would also like to have the option of employing these codes for certain Boolean and logical mathematical symbols. In support of this recommendation, I am forwarding the following information and arguments.

My field is information retrieval -- the indexing and selection of library materials and documents. During the past fifteen years I have been concerned with designing, executing, and advising on machine methods for information retrieval systems. I hold several patents in this field, and my advice is sought nationally and internationally in the planning of present and future mechanized retrieval systems. I have also been intimately connected with the digital computer field, through working in their design, since 1945. Because of recent computer developments, especially of high speed printers, I have been re-assessing the application of computers to information retrieval and to the extended field of text manipulation during the past three years. It now appears that a crucial tool for the full exploitation of the computer for this purpose will be the use of groups of teletypewriters connected on an "interrupt basis" into a central computer, i.e., the use of "reactive typewriters." (Cf. C. N. Mooers, Communications of the ACM, p. 48, v. 6, January 1963.)

In such an application of teletypewriters to the future development of this field, it is essential that the teletypewriters have the capability of printing from a character set which is larger than a certain minimal size. As an absolute minimum for working with American English text, we require 26 upper case Roman and 26 lower case Roman letters, the ten Arabic numerals from 0 to 9, and something more than twelve marks of punctuation. This minimal requirement results in the need for at least 74 printing characters, even though the set omits underline, dollar sign, cents sign, dieresis (umlaut), asterisk, number or pound sign, brackets, or other signs which are often very desirable. Therefore, it is clear that a repertory of only

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NMAH 310/4

64 printing characters is absolutely not enough for working with American English or British English text. The character requirements for working upon text within any one of the European languages based upon the Roman alphabet are equally stringent. For work with text in two or more such languages with a fixed character set, it can be asserted that substantially more than 85 printing characters will be required.

For my work in mathematics, a different set of optional characters will be advantageous, with such things as cup and cap from lattice theory, implication, forward arrow, and other signs. Again, experience has shown that more than 64 printing characters are very desirable.

Both of these requirements -- work in text and in mathematics -- can be very well satisfied if the unassigned codes with the prefixes 110 and 111 are available to cooperating groups for their optional choice as printing characters.

Rigid assignment of these codes to control functions would preclude use of these codes as optionally-chosen printing characters. However, the converse is not true, since if this recommendation is followed, these codes would still be useful as optionally-chosen control codes for those who desire to use them in this manner.

It should be noted that by this recommendation, the standardization of the printing characters with the prefixes 010, 011, 100, and 101 is not modified, and these will be available as standard codes and characters for communication outside any reactive typewriter cooperating group.

For reactive typewriter purposes, the proposed X3.2 standard has more than enough codes for the control of external devices. However, since the code was apparently devised for use primarily with character printing devices (and human interfaces) there is some serious question in my mind as to whether there are enough codes for control of the character printing devices themselves. For example, we will eventually desire such things as reverse line feed, carriage back space, color shift, print suppress, and possibly other things. These should preferably be single codes. On the other hand, for the control of external non-printing devices, code groups (i.e., a meta sign followed by any symbol) would seem to be preferable to single codes. Moreover, the use of codes in groups seems to be employed in practice for external device control, with the requirement (for safety) that a keyboard-generated code be repeated thrice to effect the named action. Finally, the rationale of encumbering the code for keyboard-printer devices with data indicating codes not accessible from the keyboard, and not acting in any way upon the printer, is not apparent to me, nor does it seem to conform to my understanding of the proper use of the capabilities of a computer or a teletypewriter. However, I can live with the assignment of these control codes, provided we can have the codes prefixed by 110 and 111 available as optionally chosen graphics.

I appreciate this opportunity to comment on the proposed standard, and will be glad to amplify any of the points I have mentioned.

Sincerely,

Calvin N. Mooers/mw

Calvin N. Mooers

CNM:mw

Appendix G

PRIVATE ASA X3 COMMITTEE DOCUMENT
NOT FOR PUBLICATION

Report on Task Group X3.2.4

Meeting time and place: June 11, 1963, Pentagon Building,
Washington, D. C.

Attendance:
R. M. Muise
A. L. Whitman
L. R. Turner
O. R. Arne
E. H. Clamons, Chairman
J. G. Doyle
W. Y. Lang
W. F. Huf
E. J. Lewis
A. F. Jones
J. L. Little
J. F. Auwaerter

Papers distributed:

ECMA TC-1 to ASA X3.2 - H. McG. Ross, Ferranti, Ltd. to J. F. Auwaerter

Draft Proposal for Joint Action by X3.2.4 and X3.2.6 by L. R. Turner

Brief report meeting of CCITT Working Party on the New Telegraph Alphabet, May 13-15, 1963

Suggested Code Assignment and Keyboard Layout for ASCII Format for Typesetting Applications dated June 10 by O. R. Arne

Sample Print-out from a special IBM 1403 Printer with Over-printing by L. R. Turner

Page 178 of GPO Style Manual

The meeting was opened by a ruling of the Chair. The resolution which had passed at the previous meeting which stated that the lower case alphabet was to be placed in the unassigned area would be considered as valid, notwithstanding the subsequent resolution of the X3.2.6 Group to the contrary.

Mr. O. R. Arne of Mergenthaler Linotype Co. presented the requirements of the graphic arts industry in the use of line-casting machines and proposed a method by which the code could be adopted to their use.

Mr. L. R. Turner of NASA presented a paper on the need for additional characters and control definitions.

Mr. J. F. Auwaerter of Teletype introduced the brief minutes of the meeting of CCITT and communications from ECMA regarding the extension of the code and possible changes to the code.

R. E. UTMAN
JUL 12 1963
BEMA/DPG

NMAH 310/9

Report on Task Group X3.2.4 (continued)

Assignments were made as follows:

> Messrs. Auwaerter, Clamons and Little to produce a rationale in favor of placing the lower case alphabet in the unassigned area
>
> Messrs. Lewis, Muise and Whitman to draft arguments for placing additional controls in the unassigned area
>
> Messrs. Turner and Lang to investigate the use of "ACKNOWLEDGE" and its possible relocation into another area

Eric H. Clamons

Eric H. Clamons

EHC.dg

Appendix I

Report of Meeting of Task Group X3.2.6 (Controls)
of Subcommittee X3.2 - June 12, 1963
Pentagon, Washington, D.C.

R. E. UTMAN
JUL 12 1963
BEMA/DPG

Attendance:

E. J. Lewis	I.E.C.
H. Spielman	R.C.A.
L. R. Turner	N.A.S.A.
J. L. Little	N.B.S.
R. F. Ewald	B.T.L.
A. L. Whitman	I.T.T. Comm. Systems
C. E. Mackenzie	I.B.M.

1) In view of the fact that a merger of X3.2.6 and X3.2.4 (unassigned area) was an item on the agenda for the following day's meeting of X3.2, a discussion on possible action was held. The points were made that the problems of both were intertwined and the membership to a great extent overlapped. The following motion was passed unanimously: X3.2.6 recommends that X3.2.4 and X3.2.6 be a combined task group.

A motion also was made that X3.2.5 (related subsets) be combined with .4 and .6, but failed of passage. The sentiment was that time would not be available in one or two day meetings to meet the obligations of all three groups.

2) Comments were presented on the Proposed Definitions of Control Characters as drawn up at the April 3 meeting. Most of the definitions about which there was question or disagreement were in the Communications Systems area and the Task Group, therefore, decided to approach X3.3 and request a joint meeting.

3) A motion was passed defining the scope of the X3.2.6 Task Group as follows:

a. Define the currently named codes in PASCII.
b. Analyze the requirements for additional control codes and make recommendations.

In the pursuit of these aims, X3.2.6 will confer with appropriate representatives of X3.3, and others, as required.

4) A discussion was held of a memo (undated) by Mr. L. R. Turner which was mailed to X3.2, X3.2.4 and X3.2.6 members about two weeks ago. The Task Group agreed that it appeared to suggest the best solution to the Bit Stream Transmission problem yet considered, and also affected the Proposed Addendum on Code Extension which had been submitted for comment to X3.2 The Task Group will continue examination of the relevant points raised by the memo and urges the X3.2 membership to study it since some of the items are outside of the responsibility of the Task Group.

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5) Two charts were received by the group for consideration:

a. An illustration of backspacing/overprinting techniques from Mr. L. R. Turner.

b. An illustration of the hierarchical nature of information separators, S_3 thru S_7, by Mr. A. L. Whitman.

H. Spielman
Chairman - X3.2.6

Appendix K

BRIEF REPORT
Meeting of CCITT Working Party on the New Telegraph Alphabet
May 13 - 15, 1963

At its Second Plenary Assembly, the CCITT decided to setup a Working Party consisting of study Groups I (telegraph operation), VIII (telegraph apparatus) and Special A (data transmission) to study a "New Telegraph Alphabet." The first meeting of this Working Party was held in Geneva, Switzerland on May 13 - 15, 1963 and was attended by the following countries and organizations:

Australia
Belgium
Canada
France
Germany
Italy
Japan
Netherlands
Sweden
Switzerland
United Kingdom
United States
International Standards Organization
World Meterological Organization

Messrs. Ross and Durand attended representing the ISO. The author of this report attended as part of the A. T. & T. Co. (U.S.A.) Delegation.

The CCITT, for some years now, recognized certain limitations in the present 5-level, alphabet No. 2. Some progress on the question of a new alphabet was made at the Warsaw meeting in 1958. Through liaison with ISO and through the work of Special Study Group A, there has developed sentiment within the CCITT that perhaps a new telegraph alphabet should be suitable for both data transmission and message telegraphy. The present group had before it the 6-and 7-bit code proposal resulting from the Paris meeting of ISO TC 97 in October, 1962.

The three day meeting based much of its work on the ISO 7-bit code proposal. The group generated a list of 135 required telegraph and data transmission signals (which were subsequently reduced to 123), generally expressed itself as inclined toward a 7 level code, disagreed on the structure which a code should assume (although the consensus appeared in favor of the ISO 7 bit structure), summarized the results of their work in a table similar to that of the ISO 7-bit proposal, planned to forward the results of its work (on a preliminary basis) to the ISO and decided to ask its constituent members (telephone and telegraph administrations) to express their opinions on the preliminary work results.

Among the points made during the meeting were the following:

1. There was no immediate or even foreseeable need to abandon or modify the present 5-level network. However, in choosing a new telegraph alphabet it is desirable to consider the needs of these public services as well as of more specialized (e.g., data) services.

2. A 7-level code is desirable because it permits a second alphabetical case for teleprinter use without the need of a mode shift. Experience with the 5-level alphabet has indicated a mode shift is undesirable.

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3. The Warsaw convention had served to reduce the number of special diacritical signs and the number of special national signs to 5 each. The diacritical marks required are ` ´ ^ " ~ , while the national signs would consist of both non-Roman alphabetical characters and special symbols.

4. A first inventory totaling 135 requirements (the "data" requirements were those in the ISO 7-bit set which the CCITT felt no need for) was developed and is attached to this report.

5. The representatives of ISO stated that there were certain parts of the 7-bit code which were "softer" than others and which were, therefore, more readily subject to replacement by substitute symbols. These were (in order of "softness"):

   i) The three characters binarily contiguous to Z (since these are pre-empted in the Scandinavian alphabet extension)

   ii) The characters ↑ ← @

   iii) The symbols ! " # CS (currency sign). The ISO representatives said they could not speak officially for the ISO in this matter but made these suggestions on the basis of their own knowledge of the field.

6. By taking advantage of the ISO suggestion the group was able to reduce what they felt to be the combined requirements and ISO and CCITT to 123 symbols.

7. The United Kingdom suggested a code structure quite similar to that of the ISO 7-bit proposal, with a number of pre-emptions for diacritical and national signs; but these suggested revisions differed from those of the ISO representatives.

8. The United States (A. T. & T. Co.) offered a code structure which was essentially identical to the proposed ASCII.

9. Germany offered a code proposal which consisted essentially of a 6-bit code containing both graphics and controls but set within the right hand (upper binary) half of a 7-bit matrix. This proposal was modified twice during the meeting to bring the 6-bit sub-set into closer agreement with the 6-bit ISO proposal. The left hand (lower binary) half of the set was devoted one quarter to controls, one quarter unassigned and one half to a second alphabetical case.

10. The German proposal met with limited acceptance.

11. A chart was prepared showing the results of the meeting's work. This chart was similar to the proposed ASCII except in the following details:

i) A lower case alphabet was placed in the Unassigned Area.

ii) The "Acknowledgement" signal was removed from its present location (without being assigned to any alternate permutation) in order to make room for lower case non-Roman alphabetical extensions.

iii) The areas suggested by the ISO representatives (See Paragraph 5 above.) were indicated reserved for national signs and diacritical marks.

12. This chart will form the basis of further work and of a report to the ISO.

The above report may contain errors because of the reporters unfamiliarity with the procedures of the CCITT. When the final CCITT report is published it will be made available to the members of X3.2.

John Auwaerter

J. F. AUWAERTER
International Representative, X3.2

JFA:JZ

	Common demands of Telegraphy and Data Processing Demandes communes à la télégraphie et au traitement des données		Additional Demand of Telegraphy Demandes supplementaires pour la télégraphie		Additional Demand for Data Processing Demandes supplementaires pour le traitement des données		Demands for transmission Demandes pour la transmission	
Lettres 1er choix Letters (first choice)	26+espace (space)	Nb 27		Nb	CS	Nb 1		Nb
(second choice) 2eme choix			26	26				
Chiffres et signes Figures and signs	figures, chiffres - ? : ( ) . , ' = / + % ;	10 11 2	Signes diacritiques Diacritical signs / \ ^ ¨ ~	5	! # " & * @ < > [ ] \ ↑ ←	13		
Fonctions Functions	Bell BS HT CR LF FF VT DC1 ... DC4 Error, DEL LEM SYNCHRO	1 6 4 2 1 1			NL SO,SI,ESC DLE IS0 ... IS7	1 4 8	SOM EOA EOM EOT WRU RU ACK	7
Usage National seulement National use only		3		2				
Total Total general = 135		68		33		27		7

part one: review and preview

THE AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

by R. W. BEMER, UNIVAC Division, Sperry Rand Corp., New York, N.Y.

It is very doubtful that Herman Hollerith ever considered, in 1905, that he would have to talk to Jean Baudot. After all, the man was dead. But this is exactly what is happening today in the inevitable marriage of computers and communications systems. The punched cards that Hollerith created must communicate with the punched paper tape of Baudot. The problem is that there is absolutely no logical similarity or relationship between the codes which represent the various letters, digits and other characters.

Hollerith designed his code for a mechanical counting reader. When cards became input to computers, as well as mechanical devices, a code correspondence had to be applied. In forming the IBM binary coded decimal (BCD) code, the 0 to 9 rows on the card were equated to 0000 through 1001, and thus the binary value corresponds to the decimal row value. Two more bits precede these to represent the four "zones" (12, 11, 0 and blank) by 00, 01, 10, and 11, although not respectively and indeed this varies among IBM equipment. Other manufacturers made different assignments in various attempts for internal economies. Assignments even vary among individual customers. Thus although most IBM users have the 12 punch as a plus sign and the 11 punch as a minus sign there are many others to whom the reverse is true.

There is a binary code inherent in the punched paper tape of Baudot, but this depends upon which tracks are made to correspond to which binary positions. Sorry to say, this choice has been made in several ways. Even so, Baudot did not make his assignment on a sequential basis for the digits or letters of the alphabet. Due to the technology of the time, it was done on the basis that the most frequently used characters would be represented by the fewest punched holes, to save wear and tear on the punch dies! To illustrate:

Letter	blank	E	T	A	O	I	N	S	H	R	D	L	U
No. of Punches	1	1	1	2	2	2	2	2	2	2	2	2	3

This should prove that there was never an actual person by that name! Apparently not much was known about digit frequency in those days, for they were assigned:

Digit	0	1	2	3	4	5	6	7	8	9
No. of Punches	3	4	3	1	2	1	3	3	2	2

Such technological conditions are largely removed now, and logical considerations assume commanding importance.

topsy in the information processing field

About four or five years ago many people awoke individually to the fact that we are in an almost impossible jumble in the coding of information. Consider the way it grew from the IBM standpoint, based upon the punched card. First came the digits 0 to 9, with & (or +) and −. So far there is only one problem, the duality of & and + as represented by the 12-punch. Now add zones for the letters. The digits 0 to 9 with a 12-punch mean A to I, with an 11-punch they mean J to R, and with a 0-punch

Mr. Bemer is an alternate member of X3.2, the X3.5 Glossary committee, and AFIP member of the IFIP TC-1 Terminology committee. Before joining Univac, where he is director of systems programming, he was with The RAND Corp. and IBM, and started the computing installation at Lockheed Missiles.

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they mean / and S to Z. Simple. But now what? Without using the other combinations of two punches (e.g. 3-6) we move directly to combinations of three punches by adding 8's. This gives such characters as . , * $ @ & and ◇. So far this can be lived with.

Now design the reader on the IBM 702 so that all illegal punch combinations are rejected; that is, only 48 out of the 4096 (2^{12}) possible combinations are legal. Now find out that more codes are needed for tape control in a computer, and so far only 48 out of a possible 64 codes available in a 6-bit character have been used. We try to see what happens for all 4096 combinations, and are surprised to find that the engineer goofed a little — nine supposedly illegal combinations slip by! So 0-2-8 is a record mark and 12-5-8 is a group mark.

On the other side of a high fence (between scientific and commercial computing at that time) the 704 people come up with FORTRAN, which needs the characters ( ) + and =, and certainly does not need % ◇ & and #. Since there are only 48 positions on the type wheels of the 407, a dual assignment is made. This makes it difficult for the installation with both scientific and commercial problems, but they learn to live with it. Along comes the 1401 with its chain printer that has 240 character positions around it, normally in five sets of 48. But it could be in four sets of 60. Because it is to be a satellite machine for many large scale installations, the FORTRAN characters are given their own separate codes for programming convenience. Now we have both dual and individual assignments in the same installation. What confusion!*

Figure 1. *American Standard Code for Information Interchange*

Example:

100 0001 = A

b_7 .... b_1

	000	001	010	011	100	101	110	111
0000	NULL	DC_0 ①	b̸	▨ 0	@	P	UNASSIGNED	
0001	SOM	DC_1	!	▨ 1	A	Q		
0010	EOA	DC_2	"	▨ 2	B	R		
0011	EOM	DC_3	#	▨ 3	C	S		
0100	EOT	DC_4 (STOP)	$	▨ 4	D	T		
0101	WRU	ERR	%	▨ 5	E	U		
0110	RU	SYNC	&	▨ 6	F	V		
0111	BELL	LEM	'	▨ 7	G	W		
1000	FE_0	S_0	(	▨ 8	H	X		
1001	HT/SK	S_1	)	▨ 9	I	Y		
1010	LF	S_2	▨ *	:	J	Z		
1011	V_{TAB}	S_3	▨ +	;	K	[		
1100	FF	S_4	▨ (comma) ,	<	L	\		ACK
1101	CR	S_5	▨ -	=	M	]		②
1110	SO	S_6	▨ .	>	N	↑		ESC
1111	SI	S_7	▨ /	?	O	←		DEL

▨ = *4 Bit Subset*

Another trouble is that the internal bit assignment for the group mark is 11 1111, and when the code is filled out to the full 64 characters possible it is found that the counting mechanical reader demands that the punch combination for the group mark be 12-7-8, particularly for the 7070 and not 12-5-8 as for the 705. However, the same tape must be capable of being read by both machines.

And so it goes, each mistake by expediency being piled on top of the last one. And so many customers already use these incompatible devices that it just doesn't seem economical to change it now. Or could it be that things will get worse and we will wish we had straightened things out last year before it gets even more expensive?

It should not be thought that IBM is the only manufacturer with such problems. UNIVAC had a similar set of problems, particularly with both 80- and 90-column cards. The RCA 501 was designed with an internal code in which the letters and digits were assigned to consecutive binary numbers, a very sensible arrangement that makes data processing much easier. This is because there is something known as a "collating" or "ordering" sequence. If there were not, it would be very difficult to find a word in the dictionary or a number in the phone book. The 501 orders by simple binary comparison, with no extra hardware or wasted time. If this seems only reasonable, remember that IBM does not make any equipment with an internal code corresponding to its collating sequence, contrary to some beliefs. Ordering is done either by special hardware ($75 a month for early 1401's) or by programming, as on the 7090. Figure 2 shows two IBM cards, punched and interpreted. Columns 1 to 64 correspond to the binary sequence 00 0000 to 11 1111, or octal 00 to 77.

Let's see what happened to that 501. The 301 was designed to aim at the extensive punched card business. What could be more natural than to forget the 501 code and adopt the internal code of the IBM 704? Later a translator was built to convert codes in both directions between the 301 and 501. Just one problem, though — any file put in order on the 301 was out of order for the 501, and vice versa. At least without programming or additional hardware. This is hardly a trivial problem. IBM calculated in 1961 (in connection with ASA work) that it might take from $5,000,000 to $30,000,000 of machine time on the fastest computers just to reorder all existing files (as necessary - most would not require it, having only numeric keys) to a new collating sequence. This is the problem IBM faced in participating in code standardization work. If a standard code were to specify the collating sequence to be identical with the binary sequence, it would not match the IBM collating sequence. Makes even a big company stop and think; it might be hard to get the customer to take the broad view of future advantages and foot the bill.

However, occasions do arise when the situation is so muddled that desperate measures must be taken. As an example, Australia will change over to its new unit of currency, the "Royal", in February of 1966. This will replace the old pound and will be divisible into 100 cents,

---

(*Author's note—I'll take my share of the blame for some of this.)

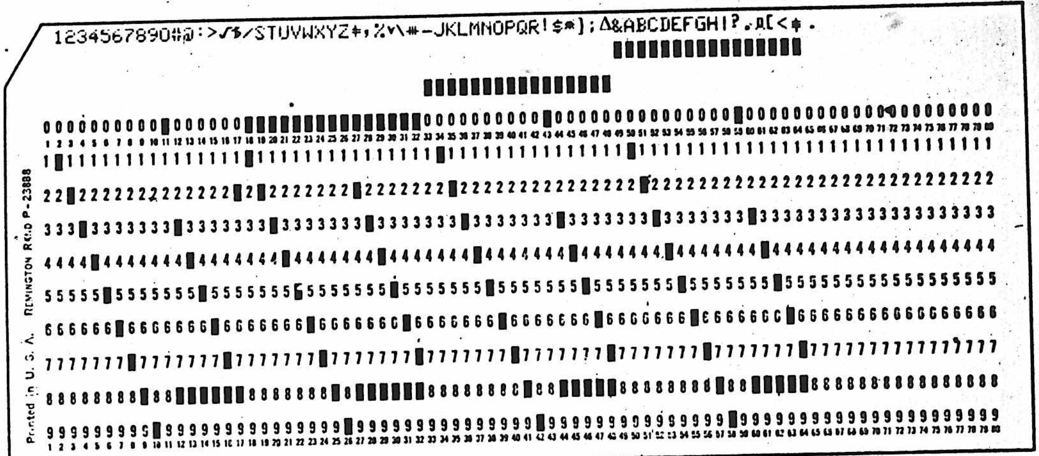
1234567890#@:>√$/STUVWXYZ‡,%v\⌗-JKLMNOPQR!$*];Δ&ABCDEFGHI?.⌑[<‡.
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Figure 2

IBM STANDARD BCD INTERCHANGE CODE (1962)

just as the dollar is. In value it will be equivalent to 12 shillings of the pound system and about $1.12 US. Such a serious step will affect almost every area of the economy, from cash registers to coin changers, from education to counting procedures. The Aussies must think it worth it in the long run, however, and even England is now considering a change, perhaps to the decimal florin.

the american standard code

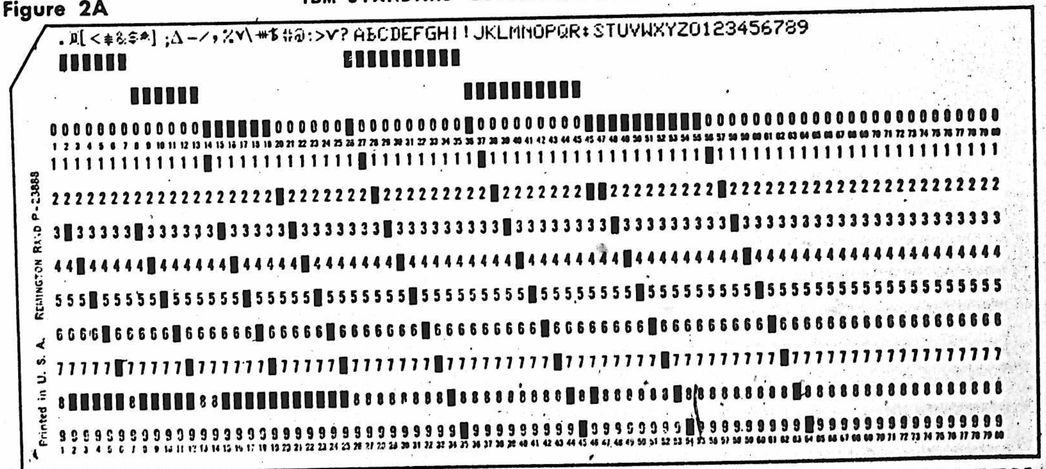
It was in a similar atmosphere of dissatisfaction with any existing system that the new American Standard Code for Information Interchange (ASCII) was developed, becoming an official ASA Standard No. X3.4 on 17 June 1963. The development and standardizing process was lengthy and sometimes turbulent. The important thing was that, as POGO says, "All was given equal chance to discuss and re-cuss." There was plenty of both. The problems of effective standardization are not new to readers of DATAMATION, but the successful adoption of a standard of this magnitude certainly is. Perhaps this success will help to reaffirm some faith in and support of these efforts.

The code was derived by the subcommittee method, one of the three ways by which an American Standard can be achieved, and certainly the most difficult. Whereas most standards are adoptions or reworks of existing practice, this code is a considerable departure from any previous code, although generic similarities to certain predecessors are certainly to be seen. Subcommittee X3.2 was chaired successively by representatives from IBM, Burroughs, and presently the Department of Defense, Navy Management Office. Several independent efforts were started in the 1958-59 period to deal afresh with the code problem. By universal agreement it was impossible to make enough sense out of existing codes; they just did not meet requirements evident at that time, nor did they provide for obvious future requirements. Among the major efforts were those of:

1. The Electronic Industries Association, a body which had produced many previous standards, working originally from a paper tape viewpoint, but later becoming general.
2. IBM, with the 8-bit code for STRETCH, which among other features provided for both upper and lower case alphabets.
3. The Department of Defense (Army Signal Corps)

Figure 2A

IBM STANDARD COLLATING SEQUENCE


.⌑[<‡&$*];Δ-/,%v\⌗$#@:>√?ABCDEFGHI!JKLMNOPQR‡STUVWXYZ0123456789
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which developed and sponsored the Fieldata code. Despite a few drawbacks, this was a great improvement upon existing codes and many of its features are to be seen in ASCII.

4. The British Standards Institution, which also started with the intention of standardizing paper tape codes and was drawn gradually into the whole data processing field.

5. The SHARE organization, which sought to coordinate their existing IBM equipment.

The abbreviations used in Figure 1 mean:

NULL	Null/Idle	CR	Carriage return
SOM	Start of message	SO	Shift out
EOA	End of address	SI	Shift in
EOM	End of message	DC$_0$	Device control ① Reserved for Data Link Escape
EOT	End of transmission	DC$_1$-DC$_3$	Device control
WRU	"Who are you?"	ERR	Error
RU	"Are you . . . ?"	SYNC	Synchronous idle
BELL	Audible signal	LEM	Logical end of media
FE$_0$	Format effector	S$_0$-S$_7$	Separator (information)
HT	Horizontal tabulation	b̸	Word separator (blank, normally non-printing)
SK	Skip (punched card)	ACK	Acknowledge
LF	Line feed	②	Unassigned control
V/TAB	Vertical tabulation	ESC	Escape
FF	Form Feed	DEL	Delete/Idle

major features of the code

Let us examine the several salient and sometimes new features of the code and their significance:

1. As yet it is only a reference code. The particular representations in media such as punched cards, punched tape and magnetic tape are not yet defined, although they are perhaps implied in some respects.

2. It is (so far) a 7-bit code, with provision to expand to 8 bits as required. In the 7-bit form, a 6-bit subset of 64 codes is assigned completely to information characters, the other 64 so far are essentially control characters. This separation can be of convenience to equipment designers in the combined data processing and communications field; it also should produce many economies.

3. Although not yet stated in the standard, there is an implied collating sequence that may be used in the straight binary comparison mode. For IBM, which presently collates digits higher than the alphabet, an Exclusive OR device in passive logic can put the digit vector higher than the alphabet. This is no more than the existing device which allows the 709 family to write and read BCD tape.

4. The set can be collapsed in a regularized and prescribed manner, if required, into a 6-bit set for existing 6-bit machines and other equipments, to a 5-bit set for modification of existing Teletype and Telex sets (particularly in Europe), and even to a 4-bit set. This latter is of very special interest, in that it can be used for cash registers and other basically numeric-only devices, but at the same time may be used in the double numeric mode for computers internally (like the 650, 7070 and STRETCH). It is indicated by the offset shaded vector in the diagram of the code. The reason for the offset is that certain nondigit characters of the 4-bit set must collate lower than both digits and alphabet when appearing in ordering keys. The reverse expansion upward is a simple matter of passive logic.

5. Certain replacements (carefully checked out internationally) allow for non-American usage. For examples, the single digits 10 and 11 (sic) for English pence can replace the colon and semicolon in the digit vector, at least until they follow the lead of the Australians; the characters following the alphabet are of relatively low usage so that they may be replaced with the additional letters of expanded Roman alphabets, particularly as used by the Scandinavian countries.

6. The ESCape code (111 1110) provides for 127 alternate sets in the 7-bit set, 255 in the 8-bit set. Some of these sets may have official standing and some may be arbitrarily reserved to certain equipments. An example might be an alternate set with the Roman alphabet replaced by the Cyrillic alphabet, the unreplaced characters remaining unchanged. The ESCape character is usually followed by another code which is devoid of its usual meaning, by virtue of following the ESCape, and indicates which one of the alternate character sets is in force until the next ESCape character is encountered.

7. The two righthand vectors were purposely reserved as the logical places to put a lower case alphabet, if desired for this to be available in a single character mode. For lesser equipments, the upper case alphabet may be used in conjunction with the Shift In (000 1110) and Shift Out (000 1111) characters to produce a lower case facility.

8. Special consideration has been given for the characters required in programming and other special languages. All of the characters of the COBOL set are included. The ESCape characters may be used to shift to one or more special sets containing all of the characters of ALGOL (including the unique lower case alphabet). Other sets may be reserved for special languages of typesetting, information retrieval, graphic design, medical reports, etc. For example, a special set for numerical machine tool control could be an alternate 4-bit subset which is identical with the standard subset in the thirteen characters 0 - 9, decimal point, plus and minus; the other three characters would be replaced by X, Y and Z for axis symbols.

9. Note that many new characters have been introduced in the control area, particularly designed for self-delimiting of streams of characters. These may be hierarchic in nature, used to describe records, fields, subfields and so forth, or they may be syntactic in nature, indicating phrases, sentences, paragraphs, etc.

why a 7-level code?

Actually ASCII is an 8-level code with the eighth bit unassigned as yet. The new A. T. & T. system, supplied with terminal equipment by its subsidiary Teletype Corp., is based completely on eight bits between start - stop pulses. This is not only for future expansion but also for practical operations today. The eighth bit may be used for parity (preferably odd) if desired, and perhaps other uses may evolve. Basically, however, the 8-bit transmission unit was selected because eight is a magic number, being a power of two. In the information theory business there is nothing more economical than a power of two, and A. T. & T. knows it. Economy is important when you are creating a whole new system of this magnitude, and indeed that magnitude may be well up into the billions. There is even provision for an eleventh digit in the direct dialing system so Teletype can tell whether an 8-bit unit (Model 33) is talking to another 8-bit unit or to a 5-bit unit, or vice versa.

Several new computers are now being designed with 8-bit capabilities. At least one model, STRETCH, is in operation. Another is reported to use ASCII internally in the double numeric mode. In certain 6-bit machines the word is designed to 48 bits to handle either six 8-bit characters or eight 6-bit characters. This code certainly facilitates transmission of pure binary data.

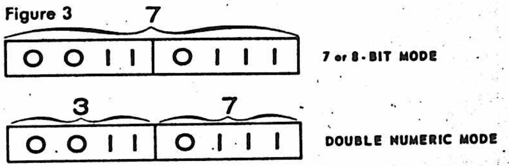
Subcommittee X3.2 appears to have no objection to the eventual assignment of meaning to all of the 256 codes in the 8-bit set. They sensibly avoided trying to be omniscient now and rather made adequate provision for expansion as further developments are made. Besides, they had to consider the Europeans and international standardization work in this area by ISO TC 97 on Computers and Information Processing. This work might not catch up to A. T. & T. for a while. Meanwhile the code will probably have to be adapted to 6-bit systems and even to five bits to work on existing Telex circuits, for the Europeans may not be able to install an entire new system in several countries in less than several years. The ASCII code is certainly set up to reduce the code size as required.

There are many advantages to having more unique codes in the set. There are some still unassigned in the 7-bit set, and of course nothing except a possible parity usage is assigned to the 8-bit set. There are several possible assignments for these spare codes, although none of these have been discussed extensively yet by X3.2:

1. A code which turns parity off and on, or possibly two individual codes, one for each of these two functions. This would facilitate compatibility between equipment using the 7-bit code with parity and other equipment desiring to utilize the full 8-bit set.

2. A code which says "repeat the transmission (it was bad) back to the last S_1 code." Presumably this code would be followed by the particular S_1 code required. This S_1 would be sent back to the transmitting equipment, which would hold it in memory and search backwards along the transmitted stream until a match was found. The transmission would be restarted at that point, both sending and receiving equipment knowing exactly where to pick up again.

Figure 3



3. Codes to ignore normal communications control so that pure binary data may be transmitted without any character meaning. These will have to be handled carefully so that return to the normal transmission mode may be effected. This might have to be done by either timing the binary transmission, sending a predetermined number of 8-bit units with automatic return, or having the receiving device actuate the return through an extra channel.

4. Codes to switch to double numeric (two 4-bit digits within a single character) and back for reasons of economy of transmission in numeric only mode. ■

(Part two of Mr. Bemer's article will be published next month.)

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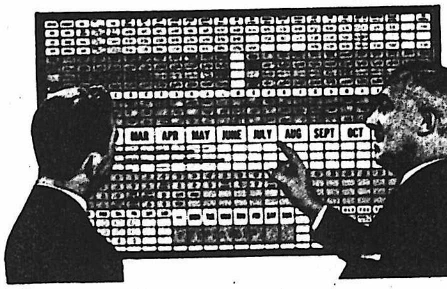

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part two

THE AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

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New York, N.Y.

Synopsis—In the first of this two-part article, Mr. Bemer covered the inglorious history of information coding which led to the ASCII, becoming an official ASA Standard No. X3.4 on June 17, 1963. He also covered its salient features, and explained the seven-bit code with provisions to expand to eight bits.

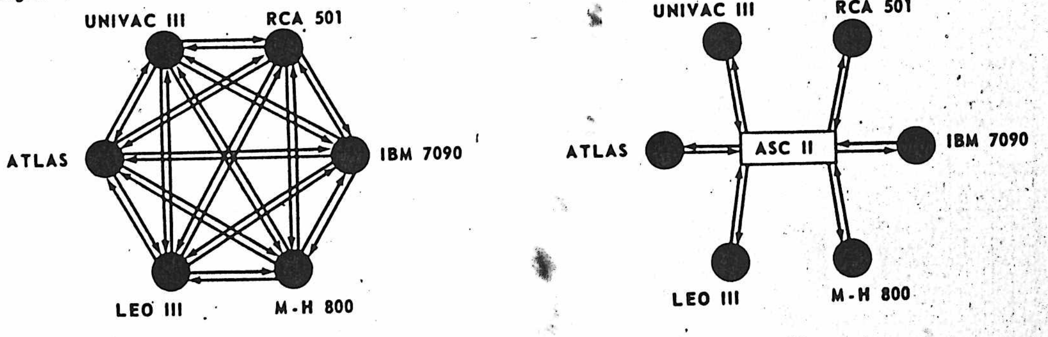
the conversion problem

The major argument against the new code seems to be the cost of converting the vast amounts of equipments and customers, with resulting obsolescence (at least of the equipment). The intent is apparent in the title of the standard – "for INFORMATION INTERCHANGE." This does *not* say that computers of external devices must be built to use this code internally, now or ever. All it demands is that whenever the computer talks with strange equipment, *not of its own kind*, that it do so through the medium of this code.

Certainly this results in fewer translation mechanisms than the present chaotic situation requires. Given N computers or other devices with various and different internal codes, each might need to talk with all the others (N-1). Thus N times (N-1) translations would be required for full intercommunication. With ASCII, however, each device needs to talk only to the standard code and back again, a total of only 2N translations required! The value of N is presently about 60 (internal codes). Although one would hardly expect that all possible 60 times 59 combinations would be used, it is certainly enough larger than 60 times 2 to say that even if every present day machine retained its own code forever, it would still be more economical to use ASCII just for interchange! Thus each machine would have to talk only to ASCII instead of 59 other codes. (See Figure 4.)

Furthermore, the possibility should not be overlooked

Figure 4



N (N-1)

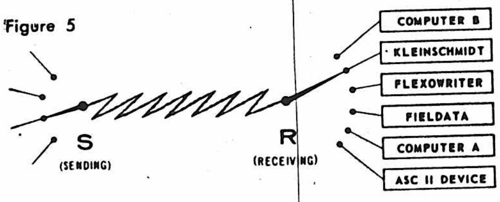
2N

that some other internal code *plus* the translation mechanisms required might be more economical for some equipment than would ASCII internally. Of course, the economic pressure for future equipments to use the code internally as well as externally would be more likely. Thus the 2N combinations might even be reduced to *one* some time in the future. The new code has so many inherent economies that it might pay for the redesign itself. IBM has perhaps the least problem of any manufacturer; with 9 different codes already in their various computers, ASCII presents only an 11 per cent additional problem.

During the conversion period, the ESCape character allows most existing codes to exist simultaneously with ASCII. Assume a communications link as in Figure 5. When a message comes along that is not in ASCII, the first character is ESCape, the next is that which selects the alternative code. The message in alternative code then follows until the next ESCape character signals either another alternative code or return to ASCII. Physically the receiving terminal R will be alerted for switching by ESCape; the following character actually performs the switching to different receiving equipment for the alternative code. This concept is much simplified, of course, and in practice might be applied only to long distance links.

It would seem a practical thing for X3.2 to assign a block of codes (to follow ESCape) to indicate the codes of existing equipments. As these become obsolete, the particular selector code may be reassigned for other purposes.

Figure 5



advantages for programming

If ASCII were to be built in as an internal computer code, the programmer might expect to see some of the following benefits:

1. Manipulation of graphics by classes. Since all characters of a certain class (such as letters, digits, etc.) are grouped contiguously, they may be classified with very few instructions. In working with strings it may be useful to create a corresponding class string in parallel for syntax analysis. This could open some interesting doors in library work and information retrieval in general.

2. Fewer instructions in scans, due to regularity and unique codes. A count once made of 709 FORTRAN showed that something like 53 instructions were required to decipher the syntactical meaning of a left partnthesis. As no other brackets were available, parentheses were used for subscripting, normal mathematical nesting and other purposes. With unique codes, the combination can form the address of the starting instruction of the routine for processing that character. Consider that the IBM FORTRAN market amounts to about $150,000,000 a year in just machine time used. The figure commonly accepted for translation from FORTRAN to machine language is 35 per cent of total time. Thus about $50,000,000 a year is spent on nothing but FORTRAN translation. Certainly

OCTAL CODE	ASCII GRAPHIC	IBM				FIELDATA	UNIVAC				RCA
		SIC A	SIC H	COLL. SEQ.	7090 CORE		1050 A	1050 H	490	1107	501
00		00	00	00	60	05	00	00	05	05	00
1	!	52	52	43	52	55	43	43	▨	▨	▨
2	"	▨	▨	▨	▨	52	▨	▨	▨	▨	05
3	#	13	▨	24	▨	▨	35	37	04	▨	36
4	$	53	53	07	53	47	42	42	47	47	07
5	%	34	▨	17	▨	▨	61	17	52	▨	10
6	&	60	▨	06	▨	▨	20	63	46	46	12
7	'	▨	14	25	14	72	15	56	72	72	13
10	(	▨	34	17	74	51	17	61	51	51	▨
1	)	▨	74	02	34	40	01	75	40	40	04
2	*	54	54	10	54	50	41	41	50	50	15
3	+	▨	60	06	20	42	63	20	42	42	▨
4	,	33	33	16	73	56	62	62	56	56	35
5	–	40	40	14	40	41	02	02	41	41	14
6	.	73	73	01	33	75	22	22	75	75	16
7	/	21	21	15	61	74	64	64	74	74	22
20	0	12	12	66	00	60	03	03	60	60	23
1	1	01	01	67	01	61	04	04	61	61	24
2	2	02	02	70	02	62	05	05	62	62	25
3	3	03	03	71	03	63	06	06	63	63	26
4	4	04	04	72	04	64	07	07	64	64	27
5	5	05	05	73	05	65	10	10	65	65	30
6	6	06	06	74	06	66	11	11	66	66	31
7	7	07	07	75	07	67	12	12	67	67	32
30	8	10	10	76	10	70	13	13	70	70	33
1	9	11	11	77	11	71	14	14	71	71	34
2	:	15	15	26	▨	53	21	21	53	53	06
3	;	56	56	12	▨	73	16	16	73	▨	11
4	<	76	76	04	▨	43	36	36	▨	43	76
5	=	▨	13	24	13	44	37	35	▨	44	▨
6	>	16	16	27	▨	45	76	76	▨	45	75
7	?	72	72	31	32	54	23	23	▨	▨	▨

SIC = STANDARD INTERCHANGE CODE

OCTAL CODE	ASCII GRAPHIC	IBM				FIELDATA	UNIVAC				RCA
		SIC A	SIC H	COLL. SEQ.	7090 CORE		1050 A	1050 H	490	1107	501
40	@	14	▨	25	▨	▨	56	15	▨	▨	▨
1	A	61	61	32	21	06	24	24	06	06	40
2	B	62	62	33	22	07	25	25	07	07	41
3	C	63	63	34	23	10	26	26	10	10	42
4	D	64	64	35	24	11	27	27	11	11	43
5	E	65	65	36	25	12	30	30	12	12	44
6	F	66	66	37	26	13	31	31	13	13	45
7	G	67	67	40	27	14	32	32	14	14	46
50	H	70	70	41	30	15	33	33	15	15	47
1	I	71	71	42	31	16	34	34	16	16	50
2	J	41	41	44	41	17	44	44	17	17	51
3	K	42	42	45	42	20	45	45	20	20	52
4	L	43	43	46	43	21	46	46	21	21	53
5	M	44	44	47	44	22	47	47	22	22	54
6	N	45	45	50	45	23	50	50	23	23	55
7	O	46	46	51	46	24	51	51	24	24	56
60	P	47	47	52	47	25	52	52	25	25	57
1	Q	50	50	53	50	26	53	53	26	26	60
2	R	51	51	54	51	27	54	54	27	27	61
3	S	22	22	56	62	30	65	65	30	30	62
4	T	23	23	57	63	31	66	66	31	31	63
5	U	24	24	60	64	32	67	67	32	32	64
6	V	25	25	64	65	33	70	70	33	33	65
7	W	26	26	62	66	34	71	71	34	34	66
70	X	27	27	63	67	35	72	72	35	35	67
1	Y	30	30	64	70	36	73	73	36	36	70
2	Z	31	31	65	71	37	74	74	37	37	71
3	[	75	75	03	▨	▨	55	55	▨	▨	▨
4	\	36	36	21	▨	▨	40	40	▨	▨	▨
5	]	55	55	11	▨	▨	77	77	▨	▨	▨
6	↑	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
7	←	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨

all of this is not due to the left parenthesis problem, but it ought to run to at least a million.

3. Faster and cheaper sorting, when the collating sequence is identical to the binary sequence of the codes for the graphics. Sorting is also big business, with commercial users quoting an average of 40 per cent of total machine time used for this one function. The elimination of special hardware for comparisons would save more than a million dollars a year.

4. Reduction in the number of routines required to be programmed, particularly for satellite equipment. The chart of Figure 6 indicates the complexity of routines that must be provided for a multiplicity of codes. The ASCII code is taken as the base code in binary sequence. The corresponding octal codes for the same graphics are given for the various other internal codes. Obviously the same procedure could be followed using any particular code as the base code. The totality of such charts provides the basic information for generalized code conversion among various equipments.

5. Fewer tables for mixed codes in communications, particularly those controlled by store-and-forward message switching systems. An IBM spokesman stated that the 7750 communications unit rents for $8,000 a month with a single code, up to $13,000 a month to handle all codes, since additional core storage is required for programs and tables to handle these other codes.

6. Clarity of printed output, particularly the reproduction of the source program in the printed record of processing. Unavailability of the exact graphic desired makes for costly mistakes in the diagnostic process. It takes quite a bit of practice to get used to reading FORTRAN with the per cent sign and lozenge used instead of parentheses.

7. A tendency for keyboards to be identical with typing communications equipment. Thus hard copy can be available immediately as a record of the program being keypunched. It is conceivable that this might extend to halfline spacing for subscripts and superscripts, a feature which might have a considerable effect in relaxing restrictions in the rules of programming languages.

the future for the ASCII code

X3.2 is presently going full steam ahead in implementing the code in the various media. This will not be a simple problem, particularly in punched cards. Presumably the binary code could be duplicated directly, a punched position standing for a 1, an unpunched position standing for 0. But there are 12 positions on the card, not 8, and that is a little wasteful. Besides, certain punching equipment will not perform up to specification when punching more than three or four holes in a column. It is possible to represent 256 codes by combinations of 0, 1, 2, and 3 punches (and no more), but this is not easy if it is required to make the combinations consistent with present punched card practice. A difficult problem, surely, but a look at the references following this paper will indicate that much work has already been done.

What will happen now to other contenders? It seems clear that Fieldata, even though implemented already in many computers, will gradually be replaced by ASCII. Indeed, Fieldata representation on X3.2 was very strong and valuable. Fortunately the Department of Defense is committed to national and commercial standards wherever they exist, even in preference to some military standards, and so Thomas Morris, Assistant Secretary of Defense, has been instrumental in the completion and adoption of the ASCII code.

It is not likely that the code will be adopted internationally in the exact form that it is in now. However, the

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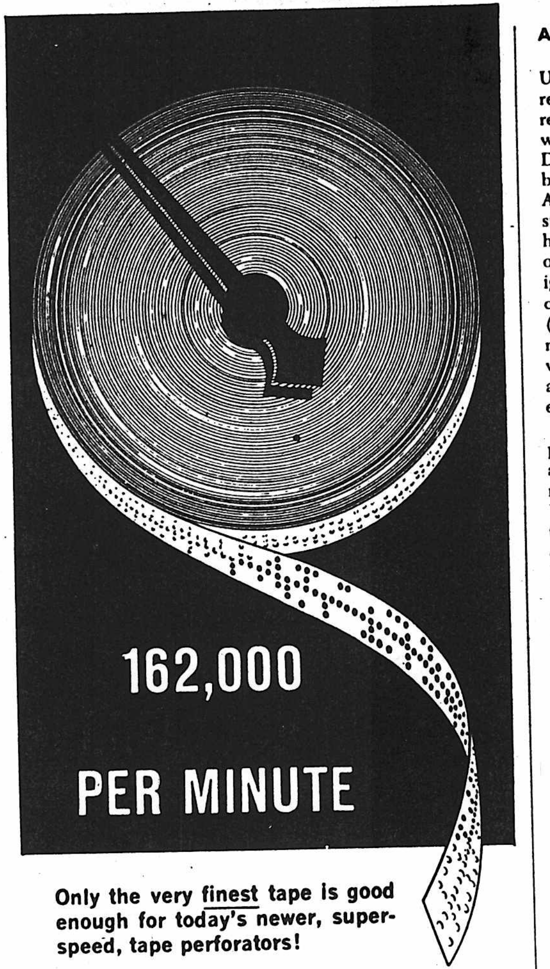

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CIRCLE 49 ON READER CARD

AMERICAN STANDARD . .

U.S. has taken considerable pains to meet international requirements and plan ahead. It is likely that a closely related code will become an international standard, in which case the ASA must simply make some modifications. Don't forget, standards are not cast permanently in bronze; they must adapt to the time and circumstances. Actually the degree of cooperation with international standards bodies and consideration of their requirements has been rather a milestone in the case of this code and other computer standards. Formerly the U.S. has either ignored or minimized international requirements. In the case of ASCII the international implications are such (satellite transmission, etc.) that full cooperation was mandatory, if only for the mundane reason that if another war were ever fought in Europe it would be a considerable advantage to be able to use existing communications equipment.

It is also a fact that the computer and information processing market outside of the U.S. is expanding greatly, and U.S. manufacturers must consider the expense of rebuilding such costly things as computers to match non-U.S. standards. It may be that the Russians will ignore this code, even though their requirements have been considered. My guess is that economic motivations of a less controlled society will win again in the American Standard Code for Information Interchange. ■

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asa

August 13, 1963

MR. R. W. BEMER
Remington Rand
650 Sepulveda Boulevard
El Segundo, California

Dear Mr. Bemer:

One of my associates, John Auwaerter, has referred to me a prepublication copy of your paper on the new American Standard Code for Information Interchange.

The article is very well done but there is one historical reference on which I would like to comment. In the third paragraph you make reference to the fact that Baudot designed his code to save wear and tear on punch dies. This tends to suggest that Baudot's work was of a rather trite nature and is somewhat characteristic of the manner in which Baudot is regarded in current writings.

The literature shows that Baudot did his work about 1875, at a time when electric utilities did not exist. These followed the invention of the electric light about 1879.

Baudot had to obtain his electric power from model 1875 batteries and his need to conserve power was very real. Since holes were punched by magnets he applied the principle of what we today call "information theory" to minimize the number of holes to be punched. He based his work on the frequency of recurrence of the letters of the alphabet as found in French text, which differs slightly from English. He therefore had a coding problem far more severe than we have today since he not only had to minimize the number of bits used for communication but also had to minimize in an equally important way his consumption of electric power.

In view of the monumental work of this pioneer I would like to suggest that you revise the last sentence of the third paragraph, if you can, to give Baudot more sympathetic treatment.

Yours very truly,
ORIGINAL SIGNED
W. J. ZENNER

Vice President

WJZ:AC

NMAH 310/4

plans will be reviewed for final policy decision at an IFIP Council Meeting in Gola, Norway, this September.

IFIP Congress 65 will present a technical program designed as a comprehensive survey of the latest achievements in the information processing sciences. The Program Committee is headed by Borje Langefors of the Swedish Society for Information Processing. Vice Chairman is Dr. Alston S. Householder of Oak Ridge National Laboratory, USA.

While the technical program will present results of new research and development of new techniques in the handling of information by computers, the actual equipment, including digital and analog computers, information storage systems, input-output systems, data communications equipment, and advanced components, will be on operational display in Interdata 65, the IFIP Congress Exhibition. Exhibits Chairman is Dr. Don Thomsen of IBM Corporation, White Plains, New York. He expects displays to occupy more than 30,000 square feet of exhibition space at the New York Hilton. A special feature of IFIP Congress 65 will be an Information Sciences Cinema, showing an international selection of the best motion pictures about this field.
(For more information, circle 64 on the Readers Service Card.)

STANDARDS NEWS

INFORMATION INTERCHANGE CODE APPROVED AS AMERICAN STANDARD

A code for information interchange between business machines and computers has been approved as an American Standard. The new computer and communications code, formerly known as pASCII (proposed American Code for Information Interchange) was approved under the procedures of the American Standards Association, as the formally designated "American Standard Code for Information Interchange, X3.4-1963".

Charles A. Phillips, director of the Business Equipment Manufacturers Association's Data Processing Group, which sponsored the development of the code, estimates that the four-year effort to develop the new standard represents an investment of $3-million.

Work was started on the new standard when it became evident that the five-channel punched paper tape and other codes in common use did not offer a sufficient number of combinations of holes or characters to accommodate the increasingly complex needs of modern data processing and equipment.

A five channel tape, for example, can record only 32 different symbols per character position (by punching a combination of one or more holes) -- not even enough to record in single character positions a complete alphabet and ten numbers. The new code, on the other hand, with its combination of seven holes per position can provide 128 different combinations. This will enable the new code to handle a wide variety of special symbols in addition to the complete alphabet and numbers.

The new standard identifies each of the 128 possible character codes in binary number language and assigns to each code an alphabetic, numerical, or special symbol or equipment control function, such as carriage return, horizontal tab and delete. It also makes provision for expansion by leaving 28 codes unassigned.

Work is continuing, to develop further extensions of the standard by representation of the coded character set in the principal information interchange media (punched tape, magnetic tape and punched cards), and for error control considerations, collating conventions, relation of the standard set to other sets, and assignment of the unassigned codes as required.

The new standard is the second to receive official ASA approval under BEMA sponsorship. Two proposed standards on magnetic character recognition are being processed at ASA, and 25 others are in some stage of development. (see Computers and Automation, July, 1963, page 11)
(For more information, circle 65 on the Readers Service Card.)

ASA EXPECTS PROGRAMMING LANGUAGE STANDARDS BY 1965

A global standard spelling out the details of programming languages for data processing machines and computers may be a certainty by the summer of next year, according to an optimistic report from the American Standards Association. The ASA expects experts from 10 nations of the world to put the finishing touches on programming languages of ALGOL, COBOL and FORTRAN in time for a mid-May committee meeting mext year in New York. If all goes well at this point, a global standard may be a reality in 1965.

Steps indicating prompt committee action came this June in Berlin when delegates from eight nations surveyed the progress of programming languages standards. Meeting as subcommittee 5 (programming languages) of Technical Committee 97, Computers and Information Processing, of the International Organization for Standardization (ISO), experts paved the way for balloting in '64 on the language proposals.

Plans now call for the International Federation for Information Processing (IFIP) to coordinate committee documents and make proposals on an ALGOL subset (to allow for efficient implementation of the language), input-output facilities and graphics and media codes of ALGOL program symbols for punched cards and punched tapes in time for the '64 meeting. Delegates indicated that international recommendations expect to establish both ALGOL and FORTRAN for scientific use and COBOL for general business use.

In other action, delegates said a review of the COBOL 61 language would hopefully eliminate conflicts between the COBOL report and practices carried out by the member-nations of the full technical committee. U.S. representatives are continuing their study in this area, with some test problems expected for presentation at next year's plenary session in New York.

The subcommittee also approved formation of a sub-group to streamline operations and evaluate criteria for any programming language to be considered as a candidate for approval as an ISO Recommendation or global standard.

Delegations from France, Germany, Denmark, Italy, Netherlands, Sweden, United Kingdom and the U.S. were present at the three-day meeting chaired by R. F. Clippinger of Minneapolis-Honeywell Regulator Company, Wellesley Hills, Massachusetts.
(For more information, circle 66 on the Readers Service Card.)

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